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ABSTRACT

This report documents study efforts to obtain information regarding the organization and performance of research and development in Pennsylvania State departments and agencies. Departmental procedures for determining research priorities, performers, project administration, and information dissemination were examined; and the relationship of these policies and arrangements to the methods for financing State research and development were analyzed. In the first part of the report the rationale for research programs is discussed, and R & D budgets, expenditures, and administration are examined. The presentation concludes with a description of the research activities for all those State departments and agencies in which descernible programs exist. (RA)

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State Organization of Research and Development
A Case Study
Commonwealth of Pennsylvania

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Preface

This report is a description and analysis of research and development activities undertaken by departments and agencies of the Commonwealth of Pennsylvania. It is one of a series of studies being conducted by the Center for the Study of Science Policy, Institute for Research on Human Resources, of The Pennsylvania State University, into the role of state and local governments with regard to formulation of national science policy. These studies are being supported by the National Science Foundation, the Pennsylvania Science and Engineering Foundation, and The Pennsylvania State University. Others in this series have focused on the conceptual design of intergovernmental systems on science relations and on state science activities.

The Center staff would like to express thanks to the state personnel who provided the information contained in this report. It was obvious from the inception of this project that departmental cooperation was necessary to produce meaningful results. Departmental personnel consented to being questioned, often in a series of lengthy interviews, on the operations of their bureaus. Many also devoted considerable time and effort to assembling the organizational and budget data requested of them. It is our hope that the combination of descriptive and analytical material contained in this report will assist them in more effectively employing scientific and technical knowledge in the provision of Commonwealth services.

Responsibility for the views expressed and conclusions drawn in this report rests with the authors, all of whom are staff members of the Center for the Study of Science Policy. The report, therefore, does not necessarily represent the official positions or views of any of the officials or agencies interviewed, or of either the Pennsylvania Science and Engineering Foundation or the National Science Foundation.

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INTRODUCTION

State governments, in general, have little input in the formulation of national science policy. Expenditures for research and development for all states in fiscal 1968 totaled $159 million, a negligible amount compared to similar federal and industrial expenditures.[1] State R & D programs respond to and work within the environment set by federal science-related legislation and policies. Within state government, science and technology for the most part are alien concepts, lacking a firm basis in tradition, organization, or appeal.

These situations may be changing. At the national level there is increasing interest in a rearrangement of the present federal-state science relations with a view toward strengthening state science capabilities. This reexamination of the present set of intergovernmental science relations is part of a general endeavor to buttress all aspects of the competencies and capabilities of state and local governments to perform more effectively. Although most public attention has been attracted to the various proposals for revenue sharing, it was apparent from the beginning of this general effort that increased revenues represented only part of the states' needs. As noted by Walter Heller, one of the earliest proponents of revenue sharing:

> If we want state and local governments to be efficient partners in our federalism, we have to strengthen the whole fabric of government at their

> levels. Great inequality in the access to knowledge, in the available skills, and in the techniques used--in a word, in the competence of government--will district and endanger the partnership. It will create disparities in the capacity for planning, and for effective action, and thus lead to inefficiency and frustration.[2]

Efforts along these lines are seen in the various revenue-sharing proposals presently being considered by Congress--for example, the Intergovernmental Revenue Act, efforts to further professionalize state government (e.g., the Intergovernmental Personnel Act), and efforts to improve the efficiency of federal-state programs (e.g., the Intergovernmental Coordination of Power Development and Environment Protection Act and the Intergovernmental Cooperation Act).

At the state level, there is a growing awareness of the benefits that could result from greater utilization of scientific and technical methods and findings in the decision-making and operational aspects of state government. Admittedly, much of the upsurge of state interest in science policy during the 1960's reflected the combination of an effort within each state to obtain a larger portion of the federal expenditures for R & D and an attempt to obtain the prestige and economic benefits believed associated with national standing as a "scientifically-minded" state. Moreover, state interest in and support of science policy mechanisms[3] has, in general, been reflected more in rhetoric and statements of aspiration than in substantive programs.

Despite these limited achievements, or perhaps because of them, states have been calling more frequently in recent years for federal support to assist state science mechanisms and for a larger role in

determining national science policy. Spokesmen for state science programs have argued that the present pattern of publically funded R & D--domination by federal funding and federal management--was appropriate when science and technology were being employed to achieve "centralized" goals, e.g., defense and space, but that it is no longer suitable for efforts directed at "distributed" goals such as those related to housing, environmental control, and health care delivery systems.[4] According to this position, some form of decentralization of science activities is essential if publically funded R & D is to produce viable solutions to this country's domestic problems.

About half of the states have established science advisory boards to provide advice to the executive, the legislature, or both. Several others are considering the desirability of such boards. All but two states have designated science advisors to serve in a liaison capacity with the National Science Foundation's Intergovernmental Science Relations program. A series of regional conferences on federal-state-local science relations and the application of science and technology to public programs have been held,[5] along with a National Conference on Goals, Policies, and Programs of Federal, State, and Local Science Agencies. Finally, a National Governor's Science Council on Science and Technology was formed in 1970. This group may develop into a nationally recognized spokesman for state involvement in federal science policies which affect state operations.

Throughout the efforts to strengthen the science capabilities of state governments and the evolving debate regarding federal-state

science relations, it was apparent that little detailed information existed on the magnitude and management of state science activities. Data on state R & D expenditures for selected years have been made available as a result of certain NSF studies.[6] A series of studies into science management and policy in six states was undertaken in 1954,[7] an assessment of state science advisory boards appeared in 1969,[8] and another in-depth study, again sponsored by NSF, of science advisory mechanisms in nine states is scheduled for publication in 1971. Most of these focus on the broad relationship between science and state government.

The present study parallels the efforts and approaches of those listed above in many ways. One area, however, has been more sharply defined in this project: the internal management of R & D. The primary focus of this study was to obtain answers to questions relating to the organization and performance of R & D within the departments and agencies of the Commonwealth of Pennsylvania. Central to this inquiry was an examination of departmental procedures for determining research priorities, performers, project administration, information dissemination, and, finally, the relationship of these policies and arrangements to the methods for financing state R & D.[9]

This focus was selected for two reasons. First, the report contains information which most Pennsylvania state officials do not currently possess. Hopefully, the descriptions and analysis in this study will contribute to the improved management of Pennsylvania's R & D efforts. Second, as previously noted, this report is part of

a larger study which is concerned with the extent to which state governments can participate more effectively in shaping and implementing national science decisions.[10] Whether state governments should be accorded more than their presently limited role in this area is a matter of debate. While little objection can be raised to strengthening capabilities to the point where each state can manage its own operations more efficiently, there is no consensus regarding whether greater state participation at the national level will enhance or detract from the presumed efficiency of the present system. In part, this disagreement derives from certain widely held assumptions and generalities about the quality of management and performance of science-related activities at the state level. The special focus of this study was undertaken to provide information on this point.

This selective interest also accounts for the absence in this report, as compared to earlier studies, of any general descriptive background summary of the economic or political conditions of Pennsylvania. Our view is that until far more is known about the management of R & D within state government, little can be done on a comparative basis to generalize among states about the relationships between political and sociological variables and state science policies.

One other aspect of state science policies which clearly merits emphasis beyond that provided in this report is the relationship between state governments and universities, particularly those supported by state appropriations. State-university relations are discussed here in terms of the present role of universities as performers of state-financed R & D, the procedures for exchanging

information between the universities and state departments, and the utility, from the viewpoint of state departments, of university-performed research.[11]

Little is said in the present study, however, of the amount or direction of research presently being funded by the state, albeit indirectly, through its general appropriation to state-related and state-owned colleges and universities. Other than rather small amounts line-itemed for research programs in the Commonwealth's General Fund budget, no information is available at the state level on what portion of state appropriations to universities and colleges is allocated internally by these institutions for research. For our purposes, this omission is not regarded as serious. It affects primarily the level of support for research and development recorded for the state, but has little impact on the organization and management of R & D within the state government. In the broad policy context, however, of determining the level of state support for R & D and for designing institutional arrangements which channel this support into areas of concern to state government, it is necessary to examine the rationale of present state-university relationships as it relates to state assistance, direct or indirect, to R & D, and of the consequences to both parties of any restructuring of the present manner of support.

This report is comprised of two parts. Part I, which contains an overview and analysis of the R & D activities of Commonwealth departments, represents our assessment of the information provided us by departmental personnel responsible for overseeing various facets of R & D. It includes a summary and conclusions (Chapter I) and discussions

of the basis for Commonwealth R & D programs (Chapter II), determination of Commonwealth research budgets (Chapter III), research program expenditures and activities (Chapter IV), research program administration (Chapter V), and university-government relations (Chapter VI).

Part II describes the research activities for all those state departments and agencies in which a discernible program existed. The material presented is intended to inform all segments of the state government on the operations of some of its component parts. Such information has not previously been available.

One aspect of the state's science-related activities which became obvious to the Center's staff as it conducted its interviews, and which was brought out forcefully in the Center's workshop on Pennsylvania's science policy, is the degree of fragmentation and obscurity surrounding these activities. R & D personnel within most departments work in almost complete isolation from their counterparts elsewhere in state government. Until recently no common forum existed for agency personnel to exchange information and explore matters of mutual concern or opportunity.[12] Likewise, the executive branch, through the Office of Administration, and the legislative branch have at best only partial information concerning the internal management procedures within each agency. Even with this information, the executive and legislative branches still lack a complete picture of the state's total efforts in the area of research and development.

No attempt is made in Part II to evaluate the caliber of a department's research program with respect to the quality of research performed or the suitability of the projects funded in terms

of some external set of research priorities. To undertake these tasks would have required competency in each of the subject areas covered by state operations, and normative judgements as to the problem areas most deserving of state attention.

FOOTNOTES

[1]National Science Foundation, Science Resource Studies Highlights, June 1, 1970, NSF 70-13 (Washington, D. C.: National Science Foundation).

[2]Walter W. Heller, New Dimensions of Political Economy (New York: W. W. Norton, 1966), p. 123.

[3]For a discussion of "state-supported science and technology mechanisms," see The Report of the Research Foundation of Kansas, June 1970, pp. 39-55.

[4]The usage of centralized and distributed goals follows that contained in The Impact of Science and Technology on Regional Economic Development (Washington, D. C.: National Academy of Sciences, 1969).

[5a]Science, Technology and State Government, Louisville, Ky., September 19-20, 1968.

[5b]The Application of Science and Technology to Public Programs, Cambridge, Mass., April 2-3, 1970.

[5c]Science and Technology and Its Application to the Problems of Pollution, Transportation and Employment, Salt Lake City, Utah, March 9-11, 1970.

[5d]Midwest Science Conference, Chicago, Ill., November 17-19, 1970.

[6]National Science Foundation, Scientific Activities in Six State Governments, 1954 (Washington, D. C.: Government Printing Office, 1958); R & D Activities in State Government Agencies, 1964 and 1965 (Washington, D. C.: Government Printing Office, 1967); Science Resource Studies Highlights, op. cit.

[7]These studies are summarized in Frederic N. Cleaveland, Science and State Government (Chapel Hill: University of North Carolina Press, 1959).

[8]Harvey Sapolsky, "Science Advice for State and Local Government," Science, Vol. 160, No. 3825, April 19, 1968, pp. 280-284.

[9]For similar studies directed at the federal government, see D. K. Price, The Scientific Estate (Cambridge: Harvard University Press, 1965); P. J. Piccard (ed.), Science and Policy Issues (Itasca, Ill.: F. E. Peacock, 1969); M. D. Regan, Science and the Federal Patron (New York: Oxford University Press, 1969); C. H. Danhoff, Government Contracting and Technological Change (Washington, D. C.: The Brookings Institution, 1968); and Organization for Economic Co-operation and Development, Reviews of National Science Policy: United States (Paris: OECD, 1968); and, United Nations Educational, Scientific and Cultural Organization, National Science Policies of the U.S.A. (Paris: UNESCO, 1968).

[10]See Irwin Feller, "Intergovernmental Science Program," paper prepared for the Federal Council for Science and Technology, Committee on Intergovernmental Science Relations (December 1969), and I. Feller, "State Science Activities: Evaluation and Recommendations," paper presented at the Workshop on State Science Activites (The Pennsylvania State University, Center for the Study of Science Policy, September 1970).

[11]These issues plus others related to the organization of Commonwealth research activities are discussed in Proceedings of the Pennsylvania Science Policy Workshop (Center for the Study of Science Policy: The Pennsylvania State University, 1970).

[12]Informal meetings of state research directors have recently been instituted for discussion of common administrative problems.

CHAPTER I

SUMMARY AND CONCLUSIONS

Basis for Commonwealth R & D Programs

The basis for research programs in the Commonwealth's functional departments and agencies rests on two propositions:

(1) Research is necessary for the support of existing operational programs which are part of the public function and duties. Through research, knowledge is obtained that permits the more efficient provision of existing services or the provision of new services which are held to be within the purview of the public sector. Because it is tied to programmatic objectives, Commonwealth R & D is "problem" or "mission oriented." It is related to the functional areas of the Commonwealth's operations.

(2) The private sector tends to underinvest in research related to governmental operations; therefore, such research must be provided for by the public sector. Although firms within the private sector can and do perform research in areas of interest to the Commonwealth, they are not likely for several reasons to undertake research in either socially optimum quantities or along socially optimum lines.

First, R & D essentially results in new knowledge. This knowledge, however, may diffuse far beyond the area of intended application

(knowledge as a public good). Second, once produced, it may be socially optimal for knowledge to be disseminated free of charge. The original activities necessary to produce the knowledge represent sunk costs while there may be zero or negligible charges to its dissemination. But if knowledge is distributed free of charge, there is no return to the private firm and thus only minimal incentive for investment in research. Third, the outcome of knowledge-producing activities is uncertain since the output can never be predicted precisely from the inputs. Fourth, a certain amount of indivisibility may be associated with efforts to secure new knowledge. This may require that research be undertaken on a scale exceeding the capabilities of private firms in the industry. Finally, fragmentation of the public market--the existence of many relatively small consumers of any new product--may dissuade firms from producing new products, because even if knowledge results from R & D the costs of marketing the new product exceed the predicted revenues from its sales.

Thus, on grounds of nonappropriability, zero marginal cost of use, uncertainty, indivisibility, and market fragmentation, it is unlikely that the expected profitability of private investment in R & D directed at securing new products and processes for the public sector will generate a level of such R & D that is socially optimal.

Determination of Commonwealth R & D Budgets

At present the Commonwealth does not consciously or explicitly decide upon its total expenditures for R & D. What is presented in this report as the Commonwealth's research budget has been pieced

together from programs and expenditures from a variety of agencies. A number of factors are responsible for this situation: (1) research funds are derived from several sources beyond General Fund appropriations; (2) research activities are contained within broader budget categories; (3) research has not been separately identifiable in a planning-programming-budgeting format; (4) research has been supported in many departments; and (5) until recently budget allocations were made exclusively on a departmental rather than on a functional basis.

Allocation decisions are, of course, made by administrators through the budget process, although government officials may find it difficult to define the exact mechanisms by which decisions are made. Decision-makers at all levels operate simultaneously, linked to each other through feedback and readjustments as the final budget structure is approached in an iterative, sequential manner. Tentative budgets are drawn at the bureau level by individuals who trade off specific variables under their command until a most-preferred combination is arrived at within stated or perceived constraints.

This process may not reconcile the diverse interests of all members of the Commonwealth's agencies, but it does satisfy many of them. The chief danger seems to be that research and related activities are not really part and parcel of the budgetary process. Instead of being viewed as a complementary means of pursuing a given operating program, research is seen as competing for scarce operating resources on a special, limited basis; it is considered a residual or slack item. Only when organizationally satisfactory budgetary amounts can be distributed to operating divisions does there appear to be a remainder

that can be utilized for research. This situation is of course reinforced by the fact that although it is only a small item in the total state budget, research is in many departments a discretionary expenditure, and thus its claims against the available funds are considered only after mandated expenditures are met.

There is no central science budget or central policy governing the allocation of resources to science and related programs. Because research is likely to remain a relatively small item in the total budget of the Commonwealth, it does not seem necessary to create an elaborate centralized mechanism to direct and control all research activities in Pennsylvania. Centralization would prove beneficial only if it could be conclusively demonstrated that uncertainty and interrelatedness are so prevalent that the existing decentralized pattern causes major researchable projects to slip between the lines of departmental activities. Moreover, in order to develop a more coordinated and efficient R & D allocation mechanism, it would be necessary for agencies and administrators to explicitly posit objectives and relationships between program expenditures and proposed steps toward stated objectives--in short, to conduct their decision-making process along the lines suggested, but by no means yet implemented by a PPB system. A central mechanism for control of Pennsylvania research activities is not necessary in the foreseeable future, although some centralization of information on a PPBS program category basis seems desirable.

Expenditures on R & D Programs and Activities

Total Commonwealth expenditures from all sources for R & D rose from $6.6 million in fiscal 1966 to $9.5 million in fiscal 1969. (The latter figure, however, represents a decline from the $10.9 million spent in fiscal 1968.) Total expenditures represent the contributions of both the Commonwealth and federal agencies. Both components have risen by roughly proportional amounts since 1966, so that the state's share of the total has remained stable within a range of from 67 to 71 percent of the total. Commonwealth expenditures rose from $4.6 million to $6.4 million, while federal expenditures rose from $2.0 to $3.2 million.

In terms of expenditures by performer, over the period since 1966, 44.2 percent of Commonwealth research was performed by in-house personnel, 27.1 percent by university researchers, and 28.6 percent by other contracting units, including federal agencies such as the United States Geological Survey.

The quantity of resources devoted to research by the Commonwealth, in terms of its total expenditures, is small. Only 0.28 percent of the General Fund ($2.7 billion) and the Motor License Fund ($752 million) was spent on research by the Commonwealth in 1969. The amou varies somewhat by program category, ranging from 0.03 percent for edu cation to 1.34 f.

Since PPBS program data are unavailable for earlier years, it is not possible to establish trends on the basis of R & D as a percentage of total program budgets. The most notable discernible changes

have occurred in the three largest program categories of R & D expenditures: health, economic development, and transportation. Taking the total Commonwealth R & D budget as a given parameter, more resources (in a relative sense) are being allocated to the program areas of economic development and transportation and fewer are available for health and education research.

R & D Program Administration

Research activities and organization within the Commonwealth may be characterized as limited, diffuse, and fragmented. Where present within a department, research generally has a limited role. It is often undertaken only in terms of crisis situations and not in an attempt to solve developing or anticipated problems. The diffuse nature of the organization of R & D activities results from the fact that research is not viewed as a separate problem leading, as other programs purportedly do, to increased governmental service. Formal and informal research activities are found in numerous subdivisions of an individual department; there is no overall coordination and administration of Commonwealth R & D at the executive or legislative level.

The fragmented nature of R & D in Pennsylvania is based upon its organizational diffuseness, budgetary considerations which compel research administrators to select short-term, marginal projects, and the large degree of isolation of agency research personnel from their counterparts in other agencies.

Despite these structures, the applied and mission-oriented nature of Commonwealth R & D requires that these activities be closely tied to functional agencies. Only the difficulty of formulating, financing, and administering interdisciplinary, "systems-oriented" projects would seem at present to require a far greater centralization of the state's R & D activities.

What is needed, however, is far greater central determination of the role of research within the Commonwealth's operations and a far more conscious determination at the executive level of the amounts to be budgeted for research along given functional and departmental lines. Only if more deliberate thought is given to the role of research in maintaining the quality of operating programs will there emerge a rational allocation of whatever sums the Commonwealth decides to allocate to R & D activities.

If the Commonwealth has a research policy, it is that research should be of a short-term nature and that it should be directly applicable to existing problems. Almost all state research personnel interviewed for this study indicated awareness of this unstated policy.

Departmental research programs are organized across a broad spectrum of formal mechanisms. Form 1 research programs are defined as those in which research is administered within a distinct bureau office in a department, the research unit appearing as a line budget item or receiving funds from earmarked sources. All research programs defined thusly had expenditures of over $150,000 a year for the period under study, and, in the majority of cases, budgets which exceeded $500,000 annually. Formal programs were identified in the following

departments and agencies: Agriculture, Commerce (including the Pennsylvania Science and Engineering Foundation), Community Affairs, Education, Health, Highways, Mines and Mineral Industries, State Planning Board (including the Bureau of Topographical and Geological Surveys), Fish Commission, Game Commission, and Eastern Pennsylvania Psychiatric Institute. These ten departments and agencies (excluding the State Planning Board) accounted for 75 percent of all research expenditures in the Commonwealth.

Informal research programs were defined during our interviews as those in which research was carried out on an intermittent and occasional basis with staff whose major duties lay elsewhere; project priorities were established without a formal screening mechanism. In addition, research expenditures in these projects rarely exceeded $150,000 annually per agency. Informal research programs existed in the following agencies: Office of Administration, Forests and Waters, Justice, Labor and Industry, Public Welfare, Revenue, State Policy, Board of Probation and Parole, Civil Service Commission, and Historical and Museum Commission.

All other Commonwealth agencies either reported no research or their research activities were of such an occasional nature that information could not be collected from agency personnel. Included in this category are the following agencies: Banking, Insurance, Military Affairs, Property and Supplies, Public Utility Commission, State, and Treasury.

Three types of research organization are found within the Commonwealth. The first, the operation-related research unit, occurs

in those agencies characterized as having formal research programs. The second, the staff research unit, is found in those agencies which have informal research programs. The third type, the line research unit, is characterized by separate budgets for agencies whose prime function is the support of a substantive research program.

Included in this last category are the Pennsylvania Science and Engineering Foundation, the Coal Research Board, and the Eastern Pennsylvania Psychiatric Institute. These units constitute organizational precedent for a comprehensive research program on a functional or departmental level.

Within some research units a shift has occurred toward greater reliance on in-house as opposed to contracted research, particularly in the case of unsolicited proposals. In general, the research organizations which concentrate on in-house research have predominantly professional staffs. In-house research is thus viewed as one means of attracting competent personnel. In addition, there is a widely shared sentiment among research administrators that unsolicited contract research is too basic for agency needs.

The processing and distribution of the results of research activities appear to pose a particularly difficult problem in some programs. Research findings which are made available to the public may be consumed by a diverse audience, including the executive branch and legislature, government officials and staff at all levels, the lay public, and the scientific community. No one research report is likely to satisfy all these groups with their differing backgrounds and

interests, which suggests that research results must be distributed by multiple means in order to effectively reach all of them.

If state agencies are to play a larger role in science policy, attract the sort of expertise needed for such a role, and place research on a solid foundation, it is essential that research findings be disseminated widely, if necessary on a face-to-face basis. The most outstanding instances of research results being translated into implementable projects have occurred when a direct capital investment plan could be tied to the results of the research program, exemplified by the Coal Research Board and the Appalachia Division of the Pennsylvania Department of Commerce. Two other agencies notable for their use of multiple implementation mechanisms are the Department of Highways and the Department of Education.

Intergovernmental and University Relations

The last forty years have witnessed significant changes in the basis of federal-state-local relationships: the restrictive concept of exclusive spheres of activity for each level of government no longer dominates. The fact that state and local officials accept federal funds does not necessarily guarantee effective programs. Current federal-state relationships create a number of problems in the conduct of research programs. First, federally funded projects are likely to involve some loss of control on the part of the state. Second, federal financial support may be terminated abruptly, with no feasible alternative available. Third, state government is likely to be understaffed in terms of qualified personnel. Fourth, state programs are likely to

be restrictive in scope due to risk and uncertainty, nonappropriability of information produced, economies of scale, and indivisibility in operation.

First, loss of control seems less likely where there exists a national organization such as the National Highway Research Council or the National Association of State Foresters. On the other hand, the Agricultural Extension Service, often suggested as an ideal model for intergovernmental cooperation, in reality gives state agencies only a small role in the area of agricultural research. Second, state agencies guard against termination of federal programs by contracting out research projects. Third, in addition to low state salaries, the lack of higher education facilities in Harrisburg hinders the Commonwealth in attracting competent personnel. Fourth, the problems of uncertainty, appropriability, indivisibility, and economies of scale are best overcome by regional research organizations. Pennsylvania contributes financially to a dozen interstate compacts, some dating from the 1940's. But over half of these interstate commissions are concerned with water resources and few are involved in coordinating research.

As a final note, it is clear that many Commonwealth agencies are dissatisfied with the quality of research produced by university researchers under state contracts and with existing contractual arrangements. The major criticisms are that (1) university research is too basic to be useful; (2) university research is often farmed out to graduate students who lack adequate training; (3) university research is rarely completed on time with contract requirements; and (4) it is not always possible to institute cancellation clauses against a

university. The result has been a general decline in state funding of unsolicited proposals.

Despite existing dissatisfaction, strong relationships exist between certain agencies and the universities, especially in the areas of education, agriculture, natural resources, and highways, and in the research program administered by the Pennsylvania Science and Engineering Foundation. Roughly half of all Commonwealth research is conducted with in-house facilities and personnel; the remainder is split fairly evenly between the universities and other contracting organizations. Existing contractual arrangements have not changed drastically, at least within the last four years. As a result, it is difficult to accept the notion that the universities have, in general, become more isolated from the responsibilities and duties of state government in the area of research.

PART I

ANALYSIS

CHAPTER II

BASIS FOR COMMONWEALTH R & D PROGRAMS

The basis for research programs in the Commonwealth's functional departments and agencies rests on two propositions:

(1) Research is necessary for the support of existing operational programs which are part of the public function and duties.

(2) The private sector tends to underinvest in research related to governmental operations, and, therefore, such research must be provided for by the public sector.

A set of questions relating to criteria for determining the total level of support for research and development, the allocation--by function or subject area--of this support, the choice of performer, and the management of R & D follow from the Commonwealth's acceptance of the legitimacy of state research and development programs. These questions are discussed in subsequent sections.

Rationale

(1) Research and development can be regarded as an integral part of the operations of the Commonwealth. Through R & D knowledge is obtained that permits the more efficient provision of existing services or the provision of new services which are held to be within the

responsibility of the public sector. Tied to programmatic objectives, Commonwealth R & D is "problem" or "mission oriented," related to the functional areas of the Commonwealth's operations.

In budgetary deliberations it is customary to regard research and operational programs as competitive, since both are funded from the revenues available. As discussed below, the combination of annual budgetary stringencies and short-run strategies endemic within governmental operations reinforces the contention that departmental and legislative appropriations for research reduce the amount otherwise available for (inadequately funded) operational programs. Viewed, however, as an investment, research expenditures add to the long-term, overall ability of the Commonwealth to provide services that approach in quality and effectiveness that which is technically and economically feasible.

Although for reasons cited below, the bulk of state R & D tends to be of an applied nature, there is nothing in the justification for Commonwealth support of R & D that rules out that basic research which is a necessary element in the solution of a problem of particular concern to the state and which cannot be performed more efficiently or is not being undertaken elsewhere. This mission-oriented justification implies, however, that the state would not support research as an end in itself or as a means toward subsidizing higher education. Both of these latter justifications have been used in behalf of research programs at the federal level.[1]

Commonwealth research is, therefore, directed toward furthering programs in those areas in which the state exercises political

jurisdiction. However, the lines between "public" and "private" spheres of operation have become increasingly blurred in recent decades. The advent of a "mixed economy" in which government, particularly at the federal level, allocates through the budgetary process a large share of national output, regulates private actions, and assumes responsibilities and provides services which formerly were the province of private groups, has altered traditional lines of demarcation. Today there exists a complex and subtle array of relationships, both within the public sector and between the public and private sectors. This blurring of areas of jurisdiction is also reflected in the subject areas in which state R & D is performed.

State government today acts to provide services or to legislate as follows:

To Provide Collective Consumption Goods. Certain goods or services if provided at all to benefit a single individual necessarily benefit a large group of people, e.g., police and fire protection, lighthouses. Information may in many cases be a collective or public good.

To Meet Social Obligations That Transcend Market Criteria. Child labor laws, mental health institutions, and public assistance programs are examples of government basing action on beliefs of social obligations relating to compassion and equity.

To Alter Differences in Individual and Collective Values. Differences between individual private costs and benefits and collective social costs and benefits represent an important area of public redirection of free market solutions. Public education, zoning laws, and environmental control are examples.

To Prevent or Correct Market Imperfections. Immobility of the factors of production, and departures from the competitive norm are situations where public intervention may take place, e.g., banking and insurance laws.

Research may be conducted in order to improve or provide new goods, services, or programs in any of the above areas. For example, research in the Pennsylvania Department of Education concerns the impact of school consolidation on the quality of education, while the Highways Department may study improved construction materials.

(2) Research activities directed at the Commonwealth's activities can be and are conducted in the private sector. Private firms which sell products to the public sector, e.g., equipment manufacturers of highway machinery or computer-assisted instructional devices, may finance research in order to enlarge their share of the public market. For many areas of Commonwealth concern, however, it is not likely that the private sector will undertake research in either socially optimum quantities or along socially optimum lines. There are several reasons for this disparity between the optimum quantity of research as perceived by a profit-making firm and that which is desirable from a societal perspective.

First, R & D essentially results in new knowledge, knowledge which may diffuse far beyond the area of intended application (knowledge as a public good). Second, once produced, it may be socially optimal for knowledge to be disseminated free of charge. The original activities necessary to produce the knowledge represent sunk costs while there may be zero or negligible charges to its dissemination.

But if knowledge is distributed free of charge, there is no return to the private firm and thus little incentive for investment in research. Third, the outcome of knowledge production activities is uncertain since the output can never be predicted perfectly from the inputs.

Fourth, a certain amount of indivisibility may be associated with efforts to secure new knowledge. This indivisibility may require that research be undertaken on a scale which exceeds the capabilities of private firms in the industry. Finally, fragmentation of the public market--the existence of a large number of relatively small consumers of any new product--may dissuade firms from producing new products, because even if knowledge is produced through R & D, the costs of marketing the new product exceed the predicted revenues from its sales.

Thus, on grounds of nonappropriability, zero marginal cost of use, uncertainty, indivisibility, and market fragmentation, it is unlikely that the expected profitability of private investment in R & D directed at securing new products and processes for the public sector will generate a level of such R & D that is socially optimal.

These considerations can be illustrated by a look at the research programs of the Department of Education and the Department of Mines and Mineral Industries. Public support of education exists as the result of a collective decision as to the desirability of providing such a service. Public education may not be "better" than private education, but it is different. To develop more efficient ways of providing the array of services that constitute public education and to improve the quality of this education, the Department of

Education conducts research on almost every facet of the total program, from school bus transportation to curriculum development to school consolidation. Educational research is often supported by private firms, but not necessarily in the amount or direction considered sufficient by the public agency.

The Coal Research Board of the Department of Mines and Mineral Industries was initially established to assist one segment of the private sector of the state's economy. The basis for such support rested explicitly on the view that the viability of the industry was crucial to the general economic well-being of the Commonwealth and implicitly on the assumption that the industry itself would not or could not undertake the research necessary to strengthen its position. In recent years, the board's research projects have been directed at offsetting the "social costs" generated by the industry's operations. Environmental pollution, black lung disease, and a high incidence of industrial accidents are by-products of the profit-making activities of producing coal. Under free market conditions, firms have little incentive or are under no compulsion to undertake R & D, or indeed any expenditures, which are directed at preventing or mitigating these social costs. This divergence of private and social costs provides a justification, if not the necessity, for state action, which may involve R & D.

The Coal Research Board's activities reflect another dimension of the difficulty of establishing purely conceptual grounds for determining the sector responsible for supporting R & D. Given (1) that the Commonwealth has an interest in preventing further pollution and

in cleansing its environment; and (2) that R & D is a necessary part of this endeavor, the Commonwealth still retains the political choice of determining who shall pay for the support of this R & D. If it so chose, the Commonwealth could require that the coal industry meet certain environmental standards, and thereby compel the firms within that industry to support the R & D which would make it possible for them to meet state environmental criteria. Legislation and regulation are ways by which the public sector can "internalize" the "externalities" associated with the actions of the private sector, and thus push back upon the immediate producer and consumer the full costs, private and social, incurred in the production of any given product. By establishing performance standards in a variety of privately determined activities, the Commonwealth could structure situations so as to provide an incentive (to avoid the losses associated with not meeting standards) to private firms to underwrite the type of R & D which is presently supported by state appropriations.

CHAPTER III

DETERMINATION OF COMMONWEALTH R & D BUDGETS

The Commonwealth of Pennsylvania does not consciously or explicitly decide upon its total expenditures for R & D. What is presented in this report as the Commonwealth's research budget represents the piecing together of programs and expenditures from numerous agencies. A number of factors have produced this situation: (1) research funds are derived from several sources beyond General Fund appropriations; (2) research activities are contained within broader budget categories; (3) research has not been separately identifiable in a planning-programming-budgeting format; (4) research has been supported in many departments; and (5) budget allocations were until recently made exclusively on a departmental rather than on a functional basis.

Similar comments could, of course, be made about the determination of science budgets at the federal level. The search continues for acceptable and operational criteria for determining the total level of support for science-related activities and its allocation among alternative areas of research.[1] However, within both the federal government and the universities, there is at least some recognition of this problem. One sign of the minimal importance attached to R & D within the Commonwealth is the scant attention paid to this issue.

FOOTNOTE

[1]See, for example, President's Science Advisory Committee, Scientific Progress, The Universities and The Federal Government (Washington, D. C.: Government Printing Office, 1960), pp. 4-5, and Harvey Brooks, "Future Needs for the Support of Basic Research," in Basic Research and National Goals, A Report to the Committee on Science and Astronautics, U. S. House of Representatives, by the National Academy of Sciences (Washington, D. C.: Government Printing Office, 1965), pp. 84-87.

Given the level of R & D expenditures in Pennsylvania, a further question concerns how much should be spent on various research programs, narrowly defined in terms of an individual bureau or division activity or more broadly defined with respect to a departmental progr or PPBS program category. In short, what are the allocation criteria for distributing the Commonwealth's R & D expenditures? No measures currently exist which permit one to determine the increased benefits to be derived from an additional dollar of expenditure on research at the program or department level. Attempts to predict or measure the costs and benefits of R & D programs a priori are likely to encounter many serious difficulties,[2] including (1) uncertainty of output given primary knowledge of the required inputs; (2) primacy of short-run political considerations; (3) difficulty of measuring intangible benefits; and (4) the possibility of trading resources for time--e.g., incurring high costs to insure earlier project completions. Of course, the closer one moves toward the applied research and development side of the R & D spectrum, the closer the relationship becomes between inputs and the expected concrete practical benefits.[3]

Despite these problems, it is evident that economic analysis should become a basic part of research programs, especially those which may be classified as applied or developmental. F. M. Scherer has outlined the different kinds of cost-effectiveness decisions which must be considered, some or all of which may be applicable to any given research project:[4]

(1) Decisions must be made about which projects to support and which to reject.

(2) The higher the technical performance and reliability sought, the more resources a project requires.

(3) The impact of a project on possible new operation resource requirements must be considered.

(4) A decision must be made as to when to start research and/or development. As time passes knowledge accumulates, better techniques become available, the unknowns in a given problem area decline, and the cost of accomplishing a special development objective falls.

(5) Government must decide how rapidly to execute the research and/or development effort.

(6) A decision must be made on how large the total program-, agency-, or government-wide research and development budget will be.

These decisions are, of course, made by administrators through the budget process, although government officials may find it difficult to define the exact mechanism by which decisions are made. A close look at the budget process suggests that it operates in a reasonable, although not entirely clear-cut fashion. Decision-makers at all levels operate simultaneously, each being linked to some degree to the others through feedback and readjustments as the final budget structure is approached in an iterative, sequential manner. Tentative budgets are made up at the bureau level by individuals who trade off specific variables under their command until a most-preferred combination is arrived at within stated or perceived constraints. No doubt these individuals are motivated partly by altruism and partly by self-interest. The budgets of the individual decentralized units are at the same time adjusted by higher authority, both at the departmental level and in the

governor's office. Again a most-preferred combination of program levels is determined. Finally, the legislature passes judgement on the overall budget.

This process may not reconcile the diverse interests of all members of the Commonwealth's agencies, but it does satisfy many of them. The main danger seems to be that research and related activities are not really part and parcel of the budgetary process. Instead of being viewed as a complementary means of pursuing a given operating program, research is seen as competing for scarce operating resources on a special, limited basis; it is considered a residual or slack item. Only when organizationally satisfactory budgetary amounts can be distributed to operating divisions does there appear to be a remainder that can be utilized for research.

This situation is reinforced by the fact that although only a small item in the total state budget, research is in many departments a discretionary expenditure, and thus it can post its claims against the available funds only after mandated expenditures are met. A seemingly common view at the state level is that determination of research expenditures is analogous to a situation in which a consumer whose income barely meets his minimum fixed costs may, if the occasion arises, spend his few discretionary dollars on such luxury items as new clothes or an expensive wine. As a consequence, administrators seem to lavish the most attention on the smallest items in the budget.[5]

Since R & D tends to be viewed as a discretionary item in the Commonwealth's budget, it is not surprising that there is no central science budget or central policy governing the allocation of resources

to science and related programs. Because research is likely to remain a relatively small item in the total budget of the Commonwealth, it does not seem necessary to create an elaborate centralized mechanism to direct and control all the state's research activities. Only if it can be conclusively demonstrated that uncertainty and interrelatedness are so prevalent that the existing decentralized pattern causes major researchable projects to slip between the lines of departmental activities would centralization prove beneficial. Moreover, in order to develop a more coordinated and efficient R & D allocation mechanism, it would be necessary for agencies and administrators to explicitly define objectives and relationships between program expenditures and proposed steps toward stated objectives--in short, to conduct their decision-making process along the lines suggested, but by no means yet implemented by a Planning, Programming, and Budgeting (PPB) system. A central mechanism for control of Pennsylvania research activities is not necessary in the foreseeable future, although some centralization of information on a PPBS program category basis would seem to be beneficial.

The major change needed to make research an integral part of state government is as much structural as substantive. More dollars for research and related activities may be desirable, but at present there is little organizational basis for considering this question. Additional funds, however, would not necessarily be spent efficiently unless research were treated as a complement to operating programs and competed on a equal basis for a share of the budget.

Conceptually, program benefits might be inferred from the cost saving that a research project permits over the best currently existing alternative, with due allowance for benefits which cannot be measured in a monetary sense. Needless to say, such measures are not currently available. Only in much more aggregate terms is there a clear relationship between R & D expenditures and economic or social indicators.[6] As a result, it is not possible to determine unequivocally if the level of research expenditures in a particular activity is too high or too low. The general tenor of the times may give some guidance, but this is equivalent to "crisis-oriented" decision-making, and is of little relevance to a government administrator or legislator seeking answers to the difficult questions posed above.

FOOTNOTES

[1]Cf. Alvin M. Weinberg, "Criteria for Scientific Choice," in Reflections on Big Science (Cambridge, Mass.: M.I.T. Press, 1967), pp. 65-100.

[2]See F. M. Scherer, "Government Research and Development Programs," in R. Dorfman (ed.), Measuring Benefits of Government Investments (Washington, D. C.: The Brookings Institution, 1965), pp. 12-13.

[3]Zvi Griliches, "Research Costs and Social Returns: Hybrid Corn and Related Innovations," Journal of Political Economy, Vol. 66, October 1958, pp. 419-431.

[4]Scherer, op. cit., p. 22.

[5]Our own study of Commonwealth R & D was questioned by an employee of the Commonwealth on the grounds that research was too small an item in the total budget to justify our concern.

[6]For example, E. Denison, The Sources of Economic Growth in the United States (New York: Committee for Economic Development, 1962); E. Mansfield, "Rates of Return from Industrial Research and Development," American Economic Review, Vol. 55, No. 2 (May 1965), pp. 310-322.

CHAPTER IV

EXPENDITURES ON R & D PROGRAMS AND ACTIVITIES

The National Science Foundation (NSF) has, for a number of years, conducted periodic surveys of the large R & D sectors of the U. S. economy--the federal government, industry, universities, and other nonprofit institutions. Collection of data on the R & D activities of state government agencies in all fifty states, exclusive of state universities and colleges, was not begun until 1964. The third level of government--local government agencies--was added to the survey coverage in 1966. Thus, while state and local R & D constitute a small, albeit growing, component of total R & D activity in the United States, little is known, quantitatively, about the level and direction of such research.

In 1954, NSF sponsored a survey of the scientific activities of six state governments, including the state-supported universities and colleges.[1] Recent changes in intergovernmental relations necessitate a reexamination of the scientific activities of particular states with respect to the quantity and nature of these activities. One change is the growth of the state science advisory mechanism and the use of special state foundations and agencies for funding research. How have these new bodies altered the relative and absolute levels of

R & D funding in the different areas in which the Commonwealth engages in research?

A second change is the increased importance of revenue-sharing methods between the federal government and state and local governments. How have decisions at the federal level altered the relative and absolute amounts spent in the different areas of state research?

Finally, the legislative and administrative process through which resources are allocated in the Commonwealth includes the option of allocating more or fewer resources to scientific activities. Improvements in the process of allocation require an accurate description of the current situation. By describing the current system, which is presently difficult to determine from its listed organizational structure, it is possible to suggest ways of improving the decision-making process.

The data on expenditures for research in the Commonwealth were collected by direct contact with agency personnel and are not without ambiguities. Appendix A is partially devoted to exploring the probable shortcomings of the data on Pennsylvania's R & D expenditures. It is worthwhile, however, to repeat some of the qualifications here.

First, the data were collected without the use of a formal survey questionnaire such as that employed by NSF. While we tried to adhere to the definitions employed in the NSF survey,[2] we had to determine whether programs and special projects classified as innovative, demonstration, planning, or program evaluation constituted or contained research activities. Various data-gathering activities, especially the initial collection, were also borderline cases between research and general purpose statistical assemblage. For example, the Department

of Commerce maintains various statistical series on natural and industrial resources in the Commonwealth. The initial assembly and analysis of such data make a basic contribution to our knowledge about the economy of Pennsylvania. Subsequent fact gathering and periodic updating of the initial report contribute to knowledge in a more general sense.

A second qualification concerns the level of departmental, in-house research expenditures. Typically, data on contract research expenditures were more readily available and retrievable for the study period than were those concerning in-house expenditures. In-house research expenditures tend to be buried in budgets which also contain expenditures for such areas as planning, data collection, and program evaluation. Any increase in research expenditures between 1966 and 1969, the period covered by this report, is partially attributable to an increase in reporting accuracy. In general, agency personnel were better able to account for in-house research expenditures during fiscal 1969 than for previous years. In some agencies, such as Public Welfare, even contracted research information was unavailable for certain years.

Despite the roughness of the data, the extent of coverage is greater than has been obtained through survey questionnaire procedures. In its studies of state R & D expenditures, NSF sent questionnaires to that bureau in a department whose title suggested it might be the most likely source of research activities. Obviously, in most cases this would be the research and planning bureau. Although the recipient of such a questionnaire might forward it to

other research administrators within his department or see to it that they also received one, the coverage obtained with this approach is less than that provided by detailed interviews in all pertinent sections of a department. The obvious difference, of course, is that the NSF studies have been concerned with all fifty states, while ours has focused solely on Pennsylvania. Our estimates indicate that the data in the NSF surveys on state R & D expenditures account for only 50-60 percent of Commonwealth R & D expenditures from all federal, state, and other sources. Moreover, while some project data may be included in our estimates which do not meet a rigorous criterion of research, any overstatement is likely to be offset by our inability to obtain complete data on expenditures for in-house research. If anything, our estimates probably understate the dollar quantity of Commonwealth R & D expenditures.

Data on Pennsylvania's research expenditures were collected from departments and, in most cases, from several bureaus or divisions within each department. Departmental figures on research expenditures are presented and summarized in Appendix A. Figures by department and bureau were then put into the Commonwealth's PPBS format for presentation and analysis in this chapter. R & D expenditures are analyzed according to the category of expenditure (PPBS), the source of funds (state, federal), and the performer of R & D (in-house, university, other contract research). Inferences with regard to the character of work (applied, basic, development) and the fields of science involved (life, physical, social) may be found in this and subsequent sections of the report.

A. Summary: Total Research Expenditures by Department (Tables I-1, I-2)

Tables I-1 and I-2 summarize total Commonwealth research expenditures in current dollars by department. These figures correspond to the individual department totals presented in Appendix A. Departmental data were then combined on the basis of the Commonwealth's PPBS format; they are given in Tables I-3 and I-4.

B. Summary: Total Research Expenditures by PPBS Program Category (Tables I-3, I-4, I-5, I-6)

Table I-3 summarizes total research expenditures in the Commonwealth according to the eight PPBS program categories. Total expenditures, federal and state, grew from roughly $6.6 million in 1966 to $10.9 million in 1968. However, some of the reported increase is due to general increases in the price level. Applying the implicit price deflator for state and local government purchases of goods and services, we arrive at the following totals, all expressed in 1966 constant dollars:

1969	$8.1 million
1968	9.7 million
1967	7.9 million
1966	6.6 million

In current dollars, the data indicate a $1.3 million drop in expenditures from 1968 to 1969. In the aggregate, this is entirely due to a decline in state appropriations. State research expenditures decreased in each program category with the exceptions of "direction," "transportation," and "recreation." The decline in state research support reflects both the Commonwealth's overall fiscal difficulties

TABLE I-1

RESEARCH EXPENDITURES BY SOURCE: SUMMARY BY DEPARTMENT
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Administration	132	--	132	132	--	132	32	--	32	32	--	32
Agriculture	315	--	315	523	--	523	612	--	612	557	--	557
Commerce	552	121	673	995	114	1,109	693	--	693	10	--	10
Community Affairs	378	30	408	206	--	206	154	--	154	50	--	50
Education	157	210	367	403	383	786	251	178	429	153	291	444
Forests and Waters	118	--	118	98	--	98	136	--	136	49	--	49
Health	874	322	1,196	597	262	859	526	210	736	463	156	619
Hospitals	785	--	785	813	--	813	737	--	737	670	--	670
Highways	423	1,268	1,691	344	1,030	1,374	163	488	651	174	522	696
Justice	14	21	35	13	5	18	--	--	--	--	--	--
Labor and Industry	106	139	245	--	137	137	--	241	241	--	131	131
Mines	334	462	796	1,381	480	1,861	485	797	1,281	541	290	831
Public Welfare	337	83	420	390	86	476	361	83	444	325	--	325
Mental Institutions	1,640	211	1,851	1,563	400	1,963	1,448	359	1,807	1,363	462	1,825
Probation	--	--	--	31	63	94	--	--	--	--	--	--
Civil Service	45	--	45	22	--	22	20	--	20	18	--	18
Fish Commission	177	174	351	176	67	243	246	34	280	213	4	217
Game Commission	37	111	148	36	109	145	36	107	143	35	106	141
Historical Commission	15	--	15	13	--	13	7	--	7	8	--	8
Total	6,439	3,152	9,591	7,736	3,136	10,872	5,907	2,497	8,404	4,661	1,962	6,623

TABLE I-2

RESEARCH EXPENDITURES BY PERFORMER: SUMMARY BY DEPARTMENT
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Administration	112	--	20	112	--	20	32	--	--	32	--	--
Agriculture	10	289	16	10	497	16	10	586	16	64	477	16
Commerce	12	510	151	42	824	243	10	465	218	10	--	--
Community Affairs	76	52	279	50	25	131	50	3	101	50	--	--
Education	335	24	8	439	220	128	273	156	--	184	259	1
Forests and Waters	11	73	34	--	71	27	--	52	84	--	12	39
Health	893	81	222	738	--	121	633	--	103	531	--	88
Hospitals	--	15	770	--	--	813	--	--	737	--	--	670
Highways	345	1,226	120	168	1,086	120	155	386	110	199	386	111
Justice	35	--	--	--	18	--	--	--	--	--	--	--
Labor and Industry	245	--	--	137	--	--	122	119	--	131	--	--
Mines	--	--	796	--	895	965	--	235	1,044	--	356	474
Public Welfare	195	--	325	98	--	378	94	--	350	--	--	325
Mental Institutions	1,851	--	--	1,963	--	--	1,807	--	--	1,825	--	--
Probation	--	--	--	31	63	--	--	--	--	--	--	--
Civil Service	45	--	--	22	--	--	20	--	--	18	--	--
Fish Commission	340	12	--	227	15	--	280	--	--	217	--	--
Game Commission	113	35	--	112	33	--	112	31	--	112	29	--
Historical Commission	13	2	--	13	--	--	7	--	--	8	--	--
Total	4,531	2,319	2,741	4,162	3,747	2,962	3,605	2,033	2,763	3,381	1,519	1,724

TABLE I-3

RESEARCH EXPENDITURES BY SOURCE: SUMMARY BY PPBS PROGRAM CATEGORY
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Direction	177	--	177	154	--	154	52	--	52	50	--	50
Protection	209	21	230	334	68	402	353	--	353	288	--	288
Health	3,586	958	4,544	4,219	1,165	5,384	3,100	1,386	4,486	2,961	908	3,869
Education	157	210	367	403	383	786	251	178	429	153	291	444
Social Development	327	63	390	380	63	443	352	63	415	325	--	325
Economic Development	1,329	484	1,813	1,716	307	2,023	1,232	264	1,496	458	135	593
Transportation	423	1,268	1,691	344	1,030	1,374	264	488	752	174	522	696
Recreation	232	148	380	185	120	305	303	118	421	252	106	358
Total	6,439	3,152	9,591	7,735	3,136	10,871	5,907	2,497	8,404	4,661	1,962	6,623
Percentage of Total	67.1	32.9	--	71.2	28.8	--	70.3	29.7	--	70.4	29.7	--

TABLE I-4

RESEARCH EXPENDITURES BY PERFORMER: SUMMARY BY PPBS PROGRAM CATEGORY
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Direction	157	--	20	134	--	20	52	--	--	50	--	--
Protection	35	155	40	37	327	38	7	277	69	7	232	50
Health	2,762	96	1,686	2,734	855	1,794	2,469	195	1,821	2,356	350	1,162
Education	335	24	8	439	220	128	273	156	--	184	259	1
Social Development	65	--	325	65	--	378	65	--	350	--	--	325
Economic Development	537	757	519	313	1,226	484	220	988	288	256	263	75
Transportation	345	1,226	120	168	1,086	120	155	386	211	199	386	111
Recreation	295	61	23	272	33	--	364	31	26	329	29	--
Total	4,531	2,319	2,741	4,162	3,747	2,962	3,605	2,033	2,765	3,381	1,519	1,724
Percentage of Total	47.3	24.2	28.5	38.3	34.5	27.2	43.0	24.2	32.8	51.2	23.0	25.8

TABLE I-5

RESEARCH EXPENDITURES AS A PERCENTAGE OF TOTAL GENERAL FUND EXPENDITURES, FISCAL YEAR 1969-70

Program Category	Total Research Expenditures[a] (000)	Total General Fund Expenditures[b] (000)	Research as Percentage of Total
Direction	$ 177	$ 88,449	0.20%
Protection	230	130,162	.16
Health	4,544	594,000	.76
Education	367	1,090,966[c]	.03
Social Development	390	79,971	.49
Economic Development	1,813	669,477	.27
Transportation	1,691	751,600[d]	.22
Recreation	380	28,441[e]	1.34
Total[c]	$9,591	$3,433,066	0.36

[a]Sources: Tables 1a and 2a.

[b]Source: Commonwealth of Pennsylvania, PPBS Program Budget, pp. 11-12.

[c]Does not include Higher Education program category, totaling $382,818,000.

[d]Motor License Fund expenditures.

[e]Does not include Various Special Recreation Funds.

TABLE I-6

R & D BY PPBS PROGRAM AS A PERCENTAGE OF TOTAL R & D

PPBS Program	1969-70	1968-69	1967-68	1966-67	Change 1966-67 to 1969-70
Direction	1.85%	1.42%	.62%	.76%	+1.09%
Protection	2.23	3.70	4.02	4.12	-1.89
Health	47.45	49.53	53.48	58.56	-11.11
Education	3.83	7.23	5.11	6.72	-2.89
Social Development	4.07	4.08	4.95	4.92	-.85
Economic Development	18.93	18.61	17.84	8.98	+9.95
Transportation	17.66	12.64	8.97	10.53	+7.13
Recreation	3.97	2.81	5.02	5.42	-1.45

and the budgetary decisions which treat research as a discretionary item. The increase in both state and federal expenditures on highway research from 1968 to 1969 can be attributed to the insulating effect of federal formula funding (see Chapter VI and the description of the Department of Highway's research program in Part II). Table I-6 further demonstrates this effect.

Commonwealth research is largely supported through state appropriations, although a portion of these funds is provided in order to match federal grants. For the four years covered by our survey, state funds accounted for 69.7 percent of total research expenditures. Federal funds, including a small amount received from other outside sources, accounted for 30.3 percent. This ratio was fairly stable during the study period: 1966-67, 70.4 percent state and 29.6 percent federal; 1967-68, 70.3 percent and 29.7 percent; 1968-69, 71.2 percent and 28.8 percent; and, 1969-70, 67.1 percent and 32.9 percent.

Data collected by NSF for 1964 and 1965 indicate that Pennsylvania did not receive federal funds or did not use federal funds for research to the extent that other states did. In 1964, all state governments together received $32.2 million in federal and all other dollars for research and development and R & D plants or 41.6 percent of the total spent by state agencies. In 1965, this amount increased to $40.4 billion or 43.3 percent of the total. However, Pennsylvania received only 7.5 and 8.0 percent of its total R & D expenditures from federal sources in 1964 and 1965, respectively. Even so, it was the fifth-ranked state in terms of state government R & D in 1965. The "federal and other" portion of R & D expenditures in the leading

states in 1965 amounted to (1) New York, 23.6 percent; (2) California, 57.7 percent; (3) New Jersey, 57.7 percent; (4) Illinois, 30.6 percent; and, (5) Texas, 50.9 percent.[3]

Whether or not Pennsylvania is "equitably" treated in the allocation of federal funds depends on the ratio of total federal payments to total federal revenues originating in the state. If some states receive more federal R & D funds than do others on either a total or per capita basis, this pattern may only partially offset the more significant redistributive effect of the remainder of the federal budget. Moreover, there is no empirical evidence to suggest that federal dollars spent to support research have any greater impact on economic development than dollars spent to support farm prices, build highways, or support military installations.[4]

For 1967 and 1968, the federal portion of total state agency R & D in the Commonwealth increased to nearly 50 percent. Pennsylvania now ranks sixth among the states, behind New York, California, Illinois, North Carolina, and Texas.[5] Preliminary figures do not allow us to determine the federal portion for the other leading states although NSF data for Pennsylvania are compatible with our survey figures in relative terms.[6]

The majority, 70 percent or roughly $7 million, of research within Pennsylvania is thus financed with state appropriations. However, some of the research projects which these dollars support might not have been undertaken had it not been for the availability of federal matching funds. Taking those departments for which federal funds are received on a matching or formula basis,[7] total research expenditures

for the last four fiscal years indicate the following relationships:

State-Direct Expenditures--61.3%

State-Assisted Expenditures--8.4%

Federal-Direct Expenditures--8.8%

Federal-Assisted Expenditures--21.6%

Thus, even on this basis, Pennsylvania directly accounts for a majority of the expenditures on research within state agencies. Roughly 8 percent or $800,000 is generated by the availability of federal matching support. However, this 8 percent includes project grants in the Department of Mines and Mineral Industries' Coal Research Board. There the availability of state funds has resulted in federal matching support and not vice versa (see Part II).

Table I-4 summarizes research expenditures by performer for the last four fiscal years. In terms of the total figures, taking all four years together, 44.2 percent of Commonwealth research was performed by in-house personnel and facilities, 27.1 percent by universities and colleges, and 28.6 percent by other contracting agencies, including federal agencies such as the United States Geological Survey. While the relative shares of each group exhibit some change from year to year, no drastic changes have occurred in the aggregate. Certain agencies, such as the research bureaus in the Department of Mines and Mineral Industries and the Department of Education, have, however, changed considerably in their preferences with regard to performer.

The absolute magnitude of research in the Commonwealth is not small; $10 million per year or $35 million over the last four fiscal years are considerable sums. However, in relative terms, the

quantity of resources devoted to research is very small. Table I-5 indicates research expenditures as a percentage of total General Fund expenditures, including federal funds received but excluding General Fund appropriations to higher education. In relative terms, only 0.36 percent of the General Fund was spent on research within the Commonwealth. The amount varies considerably by program category, ranging from 0.03 percent in education to 11.53 percent in transportation. Any similar comparison arrived at by including all the special funds or expressing the data on a per capita basis would no doubt reflect a similar conclusion.

Since PPBS program data are unavailable for earlier years, it is not possible to cite any trends on the basis of R & D as a percentage of total program budgets. However, trends can be established by examining the relative shares of R & D spending under each PPBS program as a percentage of total R & D effort in the Commonwealth (Table I-6). Since some R & D programs (direction, protection, recreation) operate from very small bases, any change may have a fairly substantial impact on the relative share of these programs. However, the most notable changes have occurred in the three largest categories of R & D expenditure: health, economic development, and transportation. Research in the area of health, by far the largest category of expenditure, experienced the greatest decline during the period 1966-67 to 1969-70, 11.11 percent. At the same time, the share of R & D accounted for by economic development increased by 9.95 percent and the share accounted for by transportation increased by 7.13 percent. Clearly, funding priorities at the state and federal

levels have altered the emphasis in Commonwealth R & D programs, vis à vis one another. Taking the total Commonwealth R & D budget as a given parameter, more resources (in a relative sense) are being allocated to the program areas of economic development and transportation and fewer are available for health and education research.

C. Research in the Program of Direction and Supportive Services (Tables I-7, I-8)

The goal of this Commonwealth program is to provide an effective administrative support system through which the goals and objectives of other Commonwealth programs can be attained. The Office of Administration and Civil Service Commission are the two agencies which conduct research under this program. Research in the former is concerned with (1) developing financial control procedures; (2) developing information systems internal to the state's operations; (3) manpower, recruitment, administration, and planning; and (4) budgetary and efficiency questions extending to all phases of the state's operations. The Civil Service Commission conducts research in the broad area of the effectiveness of personnel selection methods in the Commonwealth.

Virtually all research under this program has been performed in-house and financed with state appropriations. Research efforts in this area represent a small although increasing portion of the total Commonwealth research program (Table I-6).

D. Research in the Program of Protection of Persons and Property (Tables I-9, I-10)

This Commonwealth program aims to provide an environment and social system in which the lives of individuals and the property of

TABLE I-7

RESEARCH EXPENDITURES BY SOURCE: DIRECTION AND SUPPORTIVE SERVICES
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Administration	132	--	132	132	--	132	32	--	32	32	--	32
Civil Service	45	--	45	22	--	22	20	--	20	18	--	18
Total	177	--	177	154	--	154	52	--	52	50	--	50

TABLE I-8

RESEARCH EXPENDITURES BY PERFORMER: DIRECTION AND SUPPORTIVE SERVICES
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Administration	112	--	20	112	--	20	32	--	--	32	--	--
Civil Service	45	--	--	22	--	--	20	--	--	18	--	--
Total	157	--	20	134	--	20	52	--	--	50	--	--

TABLE I-9

RESEARCH EXPENDITURES BY SOURCE: PROTECTION OF PERSONS AND PROPERTY
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Justice	14	21	35	13	5	18	--	--	--	--	--	--
Probation and Parole	--	--	--	31	63	94	--	--	--	--	--	--
Forests and Waters	62	--	62	68	--	68	80	--	80	45	--	45
Agriculture	133	--	133	222	--	222	273	--	273	243	--	243
Total	193	21	214	334	68	402	337	--	337	272	--	272

TABLE I-10

RESEARCH EXPENDITURES BY PERFORMER: PROTECTION OF PERSONS AND PROPERTY
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Justice	35	--	--	--	18	--	--	--	--	--	--	--
Probation and Parole	--	--	--	31	63	--	--	--	--	--	--	--
Forests and Waters	--	38	24	--	46	22	--	27	53	--	12	34
Agriculture	--	117	16	6	200	16	7	250	16	7	220	16
Total	35	155	40	37	327	38	7	277	69	7	232	50

individuals and organizations are protected from natural and man-made disasters and from illegal and unfair action. Research under this program is performed by the Board of Probation and Parole and Department of Justice, Department of Forests and Waters, and Department of Agriculture. The first two agencies conduct research under the program category entitled Control and Reduction of Crime. Very little research has been performed by either agency in spite of or because of the urgency of the crime problem. Virtually no research has been conducted on probation and parole in Pennsylvania despite the fact that, compared to prison confinement, these are considerably cheaper methods of supervising criminal offenders.

The Department of Forests and Waters through its Bureau of Engineering conducts research projects under the program category Water Damage Control and Prevention. The Department of Agriculture's research under the broader program has been concerned with animal and plant diseases and control. Both agencies rely heavily on contracted research projects with the Commonwealth's universities.

Financing of research under the heading of "protection" has come mainly from state appropriations. The relative decline in Commonwealth R & D under this category (Table I-6) may be attributed to the decline in funds available for agricultural research through the State Fair fund (see description of the Department of Agriculture's research program in Part II).

E. Research in the Program of Health--Physical and Mental Well-Being (Tables I-11, I-12)

The goal of this program is to provide a healthful environment and to ensure that all citizens of the Commonwealth are afforded a comprehensive, high quality medical care system. This is the largest area of research in the Commonwealth, accounting for roughly half of all research expenditures.

Substantive areas of research under this program include (1) physical health problems, including the delivery and preventive activities of the Department of Health and categorical research grants (cancer, cerebral palsy, cerebral dysfunctions, cellular biology, cardiovascular disorders, and aging) to eight hospital research centers; (2) mental health problems, which includes research in the prevention and treatment of mental illness and mental retardation conducted in the Department of Public Welfare and at six Commonwealth mental institutions; and (3) environmental health problems, including the air and water pollution control programs of the Department of Health (Bureau of Environmental Protection) and the Department of Mines and Mineral Industries (Coal Research Board).

Relative expenditures on research under these three areas are approximately as follows:

Percentage of Total Health R & D

Area	1969-70	1968-69	1967-68	1966-67	Average 1966-69
Physical	33.5	24.0	25.7	26.2	27.2
Mental	41.4	37.1	40.9	47.2	41.2
Environmental	25.1	38.9	33.4	26.6	31.5

TABLE I-11

RESEARCH EXPENDITURES BY SOURCE: HEALTH--PHYSICAL AND MENTAL WELL-BEING
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Health	862	322	1,184	597	262	859	526	210	736	463	156	619
Hospitals	785	--	785	813	--	813	737	--	737	670	--	670
Public Welfare	10	20	30	10	23	33	9	20	29	--	--	--
Mental Institutions	1,640	211	1,851	1,563	400	1,963	1,448	359	1,807	1,363	462	1,825
Mines and Mineral Industries	289	405	694	1,236	480	1,716	380	797	1,177	465	290	755
Total	3,586	958	4,544	4,219	1,165	5,384	3,100	1,386	4,486	2,961	908	3,869

TABLE I-12

RESEARCH EXPENDITURES BY PERFORMER: HEALTH--PHYSICAL AND MENTAL WELL-BEING
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Health	881	81	222	738	--	121	633	--	103	531	--	88
Hospitals	--	15	770	--	--	813	--	--	737	--	--	670
Public Welfare	30	--	--	33	--	--	29	--	--	--	--	--
Mental Institutions	1,851	--	--	1,963	--	--	1,807	--	--	1,825	--	--
Mines and Mineral Industries	--	--	694	--	855	860	--	195	981	--	350	404
Total	2,762	96	1,686	2,734	855	1,794	2,469	195	1,821	2,356	350	1,162

Taking all four years together, physical health research accounted for 27.2 percent; mental health research, 41.2 percent; and environmental health research, 31.5 percent of R & D expenditures in this program category. Explicitly or implicitly, mental health research is the number one priority item in the Commonwealth's research budget although the absolute level of expenditures has not increased in the last four years.

Research under the health program has been financed through both state and federal appropriations, on an approximately 75-25 state-federal basis. State expenditures on mental health have largely gone to research projects in one institution, the Eastern Pennsylvania Psychiatric Institute (see Part II).

F. Research in the Program of Intellectual Development and Education (Tables I-13, I-14)

The goal of the Commonwealth's education program is to provide a system of learning experiences and opportunities that will permit each individual to achieve his maximum potential intellectual development through services provided in the areas of preschool, elementary and secondary, vocational, higher, and continuing adult education.

Four bureaus in the Department of Education conduct traceable research. The Bureau of Research has, in the past, dealt mainly with basic education (preschool, elementary and secondary, vocational, and continuing adult education). In the future more research may be performed in the area of higher education. The Bureau of Curriculum Development and the Bureau of Educational Quality Assessment have been

TABLE I-13

RESEARCH EXPENDITURES BY SOURCE: INTELLECTUAL DEVELOPMENT AND EDUCATION
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Education	157	210	367	403	383	786	251	178	429	153	291	444

TABLE I-14

RESEARCH EXPENDITURES BY PERFORMER: INTELLECTUAL DEVELOPMENT AND EDUCATION
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Education	335	24	8	439	220	128	273	156	--	184	259	1

concerned, respectively, with effective administration of Title I and Title III appropriations under the Elementary and Secondary Education Act of 1965, and with assessment of the impact of the Commonwealth's school consolidation plan. Finally, the Bureau of Planning (formerly the Bureau of Institutional Studies and Services) in the Office of Higher Education works to provide research services in the area of higher education.

Relative to total department expenditures, education R & D is the smallest program in the Commonwealth, accounting for only 0.03 percent of total education program expenditures in 1969-70 (Table I-5). Relative to other R & D programs, the share attributable to education appears to be declining (Table I-6) although there is no clear trend. Of course, much research in the area of education is concentrated in the educational institutions themselves.

G. Research in the Program of Social Development (Tables I-15, I-16)

The goal of this program is to provide a system of services for reinforcing the capacity of individuals and families for effective adjustment to society and for minimizing socially aberrant behavior. Research in the Department of Public Welfare appears to be concerned mainly with the program category of general administration and Support. That is, information that was available on R & D under this program indicates that the major concern has been cost efficiency under current programs rather than the development of new programs.

TABLE I-15

RESEARCH EXPENDITURES BY SOURCE: SOCIAL DEVELOPMENT
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Public Welfare	327	63	390	380	63	443	352	63	415	325	--	325

TABLE I-16

RESEARCH EXPENDITURES BY PERFORMER: SOCIAL DEVELOPMENT
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Public Welfare	65	--	325	65	--	378	65	--	350	--	--	325

H. Research in the Program of Economic Development and Income Maintenance (Tables I-17, I-18)

The goal of this program is to provide a system in which the employment opportunities of individuals, the economic growth and development of communities, and the overall economic development of the Commonwealth will be maximized. Eight agencies contribute to the R & D effort supporting economic development and income maintenance in the Commonwealth. Four agencies are basically concerned with the substantive area of natural resources: Departments of Agriculture, Forests and Waters, Mines and Mineral Industries, and the Fish Commission. Two agencies, the Department of Health and the Department of Labor and Industry, are concerned with labor resources and income maintenance. The Department of Community Affairs deals with local community development; the Department of Commerce concentrates on industrial development.

This is the second largest area of research in the Commonwealth and, because of state financing of research in the Departments of Commerce and Community Affairs, also the area which showed the greatest relative gain from 1966 to 1969 (Table I-6).

I. Research in the Program of Transportation and Communication (Tables I-19, I-20)

The purpose of this program is to provide a system for the fast, efficient, and safe movement of individuals, cargo, and information within the Commonwealth which is interfaced with a national-international system of transportation and communication. This is a major area of research within the Commonwealth, one which currently

TABLE I-17

RESEARCH EXPENDITURES BY SOURCE: ECONOMIC DEVELOPMENT AND INCOME MAINTENANCE
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Agriculture	182	--	182	301	--	301	339	--	339	314	--	314
Forests and Waters	40	--	40	30	--	30	30	--	30	4	--	4
Health	12	--	12	--	--	--	--	--	--	--	--	--
Labor and Industry	106	139	245	--	137	137	--	241	241	--	131	131
Mines and Mineral Industries	45	57	102	145	--	745	105	--	105	76	--	76
Commerce	552	121	673	995	114	1,109	693	--	693	10	--	10
Community Affairs	321	30	351	206	--	206	53	--	53	50	--	50
Fish Commission	71	137	208	39	56	95	12	23	35	4	4	8
Total	1,329	484	1,813	1,716	307	2,023	1,232	264	1,496	458	135	593

TABLE I-18

RESEARCH EXPENDITURES BY PERFORMER: ECONOMIC DEVELOPMENT AND INCOME MAINTENANCE
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Agriculture	10	172	--	4	297	--	3	336	--	57	257	--
Forests and Waters	--	35	5	--	25	5	--	25	5	--	--	5
Health	12	--	--	--	--	--	--	--	--	--	--	--
Labor and Industry	245	--	--	137	--	--	122	119	--	131	--	--
Mines and Mineral Industries	--	--	102	--	40	105	--	40	65	--	6	70
Commerce	12	510	151	42	824	243	10	465	218	10	--	--
Community Affairs	50	40	261	50	25	131	50	3	--	50	--	--
Fish Commission	208	--	--	80	15	--	35	--	--	8	--	--
Total	537	757	519	313	1,226	484	220	988	288	256	263	75

TABLE I-19

RESEARCH EXPENDITURES BY SOURCE: TRANSPORTATION AND COMMUNICATION
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Highways	423	1,268	1,691	344	1,030	1,374	163	488	651	174	522	696
Community Affairs	--	--	--	--	--	--	101	--	101	--	--	--
Total	423	1,268	1,691	344	1,030	1,374	264	488	752	174	522	696

Table I-20

RESEARCH EXPENDITURES BY PERFORMER: TRANSPORTATION AND COMMUNICATION
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Highways	345	1,226	120	168	1,086	120	155	386	110	199	386	111
Community Affairs	--	--	--	--	--	--	--	--	101	--	--	--
Total	345	1,226	120	168	1,086	120	155	386	211	199	386	111

receives a greater absolute quantity of federal funds for research than any of the other seven major programs.

Research in the Department of Highways (which is now incorporated in the Pennsylvania Department of Transportation) is concerned with the development and analysis of highway construction materials and methods. University researchers are heavily relied on for these studies.

The Mass Transportation Division in the Department of Community Affairs has contracted for research studies on the economic feasibility of mass transportation in the Commonwealth.

J. Research in the Program of Recreation and Cultural Enrichment (Tables I-21, I-22)

This program's goal is to make available sufficient opportunities for individual and group recreation and cultural growth. R & D activities include development of sport fish and game (Fish Commission, Game Commission), state parks and local recreation facilities (Department of Forests and Waters, Department of Community Affairs), and historical sites (Historical and Museum Commission).

Most of the research under this program is performed in-house with Commonwealth facilities and personnel.

TABLE I-21

RESEARCH EXPENDITURES BY SOURCE: RECREATION AND CULTURAL ENRICHMENT
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Forests and Waters	16	--	16	--	--	--	26	--	26	--	--	--
Community Affairs	57	--	57	--	--	--	--	--	--	--	--	--
Historical Commission	15	--	15	13	--	13	7	--	7	8	--	8
Fish Commission	107	37	144	136	11	147	234	11	245	209	--	209
Game Commission	37	111	148	36	109	145	36	107	143	35	106	141
Total	232	148	380	185	120	305	303	118	421	252	106	358

TABLE I-22

RESEARCH EXPENDITURES BY PERFORMER: RECREATION AND CULTURAL ENRICHMENT
(In Thousands of Dollars)

Department	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Forests and Waters	11	--	5	--	--	--	--	--	26	--	--	--
Community Affairs	26	12	18	--	--	--	--	--	--	--	--	--
Historical Commission	13	2	--	13	--	--	7	--	--	8	--	--
Fish Commission	132	12	--	147	--	--	245	--	--	209	--	--
Game Commission	113	35	--	112	33	--	112	31	--	112	29	--
Total	295	61	23	272	33	--	364	31	26	329	29	--

FOOTNOTES

[1]National Science Foundation, Scientific Activities of Six State Governments, Summary Report on a Survey, Fiscal Year 1954 (Washington, 1958). The six states covered are California, Connecticut, New Mexico, New York, North Carolina, and Wisconsin.

[2]The NSF questionnaire defines R & D activities as "experiments or investigations the purpose of which is to discover or interpret facts or to develop practical applications of such research . . . . Research is to be distinguished from fact-gathering . . . . Research does not include routine product testing, quality control, and activities concerned primarily with the dissemination of scientific information and the training of scientific manpower."

[3]National Science Foundation, R & D Activities in State Government Agencies, Fiscal Years 1964 and 1965 (Washington, 1967), Table B-24, p. 44.

[4]See Irwin Feller and Wesley Long, "State Support of R & D as a Method of Stimulating Economic Development," paper presented at Science Policy Workshop, Center for the Study of Science Policy, The Pennsylvania State University, September 1, 1970.

[5]National Science Foundation, Science Resources Studies Highlights (Washington, July 1, 1970), pp. 2-3.

[6]Preliminary data supplied the authors through the courtesy of NSF indicate federal shares for Pennsylvania of 27.1 and 31.0 percent in 1967 and 1968, respectively.

[7]This category includes the Departments of Education, Health, Highways, Justice, Mines and Mineral Industries, and Public Welfare, in addition to the Board of Probation and Parole, Fish Commission, and Game Commission.

CHAPTER V

R & D PROGRAM ADMINISTRATION

The previous chapters have reviewed the rationale for research programs as part of state government operations, the determination of R & D expenditures, and the current level of financial commitment by the Commonwealth to such activities. This chapter analyzes the policies and methods by which such programs are organized and administered. It is difficult to discuss the conduct of research activities with regard to distinct, coherent administrative policies and decisions. We are required here to infer the nature of research administration from the type of organization within which these activities are conducted, from broad statements of research policy, and from our investigation. This chapter discusses Commonwealth research policies, organizational structure for the administration of research activities, departmental efforts at program development and coordination, and departmental procedures for the dissemination of research results.

A. Commonwealth Research Policies

Research activities and their organization within the Commonwealth may be characterized as limited, diffuse, and fragmented. The limited extent of total Commonwealth R & D has already been suggested

by the expenditures listed in Table I-3. Where present within a department, research generally has a limited role. Problem-solving research is likely to be undertaken only in terms of crisis situations and not to solve developing or anticipated problems.

The diffuse nature of the organization of research and related activities is accounted for by the fact that research is not viewed as a separate program leading, as other state programs purportedly do, to increased public welfare, economic development, or more efficient governmental operation and control. Consequently, formal and informal research activities may be found in numerous subdivisions of an individual department. Some central coordination is possible at the departmental level, but this is exercised mainly on total expenditures rather than on research priorities. No overall coordination and administration of Commonwealth R & D exists at the executive or legislative level. Many agencies interviewed in this study were unable to provide a clear definition of the role of research in their operational programs or a precise accounting of their research expenditures. In many cases, funds for research activities are included with funds for operating programs or research related activities (e.g., planning, data collection). This makes it extremely difficult to ascertain an individual department's commitment to problem-solving research.

The fragmented nature of Commonwealth R & D is based upon organizational diffuseness, budgetary considerations which compel research administrators to select short-term, marginal projects, and the isolation of agency research personnel from their counterparts in other agencies.

These comments on the state's R & D activities must be viewed in perspective. Pennsylvania's expenditures on R & D, using NSF estimates, placed the Commonwealth sixth among the states for fiscal 1968. The diffuse nature of the organization of R & D follows from the mission-oriented direction of this research and the view that such research should be organizationally situated as close as possible to the programs it is designed to improve. In this respect, the organization of Commonwealth R & D mirrors that of that federal R & D which is carried out within mission-oriented departments, e.g., Agriculture and Health, Education, and Welfare. Indeed, to further the comparison with the organization of R & D at the federal level, the argument that applied research should be closely tied to an agency rather than performed through some form of service arrangement by a centralized research institute would apply even more at the state level, where almost all research is of an applied nature. The arguments for centralization at the federal level--overlapping projects, interdepartmental competition for the same body of limited scientific and technical manpower, the need to organize interdisciplinary projects--have less applicability at the state level. Only the difficulty of formulating, financing, and administering interdisciplinary "systems-oriented" projects would seem at present to justify far greater centralization of the Commonwealth's R & D activities.

What is needed, as noted above, is far greater central determination of the role of research within the Commonwealth's operations and a far more conscious determination at the executive level of the

amounts to be budgeted for research along given functional and departmental lines.

In his 1955 report on Science and State Government, Frederic Cleaveland noted that a state government by "developing policy on scientific activities at the departmental level tends to reinforce the concept that research is one of the available means to pursue an operating program."[1] Several interviewees expressed the opinion that their research programs receive disproportionate cuts during the budgetary process. This opinion, which appears to be supported in fact, has certain detrimental effects:

1. It encourages short-term projects of limited or marginal contribution to operating programs.

2. It encourages burying or hiding research programs in operating programs, with a consequent loss of information.

Only if more deliberate thought is given to the role of research in maintaining the quality of operating programs will a balance emerge in the distribution of funds. Exactly how the new PPB system and the Pennsylvania Bureau of the Budget can aid in producing a balance of funding is unclear. Presently, research personnel view the Bureau of the Budget as an obstacle, where decisions are made arbitrarily.

If the Commonwealth can be said to have a research policy, it is that research should be of a short-term nature and that it should be directly applicable to currently existing problems. Almost all research personnel interviewed, whether in formal or informal research programs, communicated to us a knowledge of or belief in this unstated policy.

Pennsylvania has, however, begun to build its case for a more comprehensive role for research in state government through the Governor's Science Advisory Committee (G-SAC), the Pennsylvania Science and Engineering Foundation (P-SEF), the Coal Research Board, the Office of Science and Technology, and the Eastern Pennsylvania Psychiatric Institute.

Because it is an advisory body, G-SAC has no funds to appropriate for research; nevertheless, it has served to define current and future opportunities for state action, some of which involve expanded research activities with line agencies. However, G-SAC does not currently provide for a systematic research input or one which can be clearly demonstrated to have had much influence at the executive level on policy or budgetary decisions relating to departmental or functional R & D. G-SAC and P-SEF represent new structural mechanisms through which an attempt is being made within the Commonwealth to determine more explicitly a state science policy. Why such a policy is necessary, what the objectives of such a policy should be, and whether any policy can be made to work have yet to be resolved.

The legislative authorization for P-SEF is

> . . . to promote, stimulate and encourage (i) basic and applied research and development in Pennsylvania and (ii) scientific and technological education in Pennsylvania, which may reasonably be expected to advance the Commonwealth's economic growth.[2]

P-SEF's initial thrust was directed at funding expanded educational facilities and research projects which contributed to the Commonwealth's economic development. Its more recent funding has

emphasized research projects which relate both to economic development and the improved provision of those services which are already supplied by existing agencies--e.g., transportation research, a proposed study of health delivery centers. In this respect, P-SEF has used its budgetary flexibility to underwrite research into directions and projects desired by line agencies. A high degree of cooperation exists between P-SEF and the line agencies, based largely on informal ties, the changing emphasis within P-SEF's board to projects which combine economic development and public goods research, and the realization within the agencies that it is often possible to get support for desired projects through P-SEF, support which might not be forthcoming from the legislature.

In consort with G-SAC, P-SEF, since 1967, has identified the following areas for financial support: (1) pollution and allied environmental programs, (2) materials science and building technology, (3) medical, biological, and allied fields, (4) marine science and engineering, (5) urban problems, (6) public health, (7) transportation, (8) nuclear energy, and (9) communications.[3]

Concurrent with the establishment of G-SAC and P-SEF was the creation in 1968 of the Office of Science and Technology within the Department of Commerce to coordinate the administration of various Commonwealth scientific and technological activities. In the main, it has dealt primarily with the activities of G-SAC, P-SEF, and the industrial aspects of the Advisory Committee on Atomic Energy and Radiation Control. The former director was also involved in presenting to federal agencies the Commonwealth's case for greater state involvement in the

formulation of national science policy. This role, however, was as much due to his joint position as executive director of P-SEF and his coordinating function with G-SAC as it was to the new office.

At present the functions and areas of responsibility of the Office of Science and Technology are unclear. It has little involvement with science-related activities in any department other than Commerce, and in no sense does it act as a central coordinating unit for Commonwealth R & D activities. Moreover, if greater central control were to be established over individual agency R & D operations, it is unclear that such control should be exercised by this office rather than one directly attached to the governor, through, for example, the Office of Administration.

The legislative statute which established the Coal Research Board states that

> The Coal Research Board is authorized to conduct, or cause to be conducted, thorough and comprehensive research studies and research programs in the technology, the economics, and the marketing of bituminous and anthracite coal and their by-products, for the purpose of developing new uses and increased markets for such coal.[4]

The applied thrust of the duties of the Coal Research Board is obvious, although basic research is not ruled out. Indeed, since its establishment in 1956, the board has shifted its research emphasis from markets to transportation techniques to pollution and economical use of by-products to mine safety (see Part II).

The ability of Coal Research Board and P-SEF personnel to define a shifting emphasis in funding priorities illustrates the general latitude permitted those research activities which relate to economic and

natural resource development. The Coal Research Board and P-SEF are examples of comprehensive research programs with at least partial central control which also permit an appreciable amount of basic research directed at major goals rather than narrow applications.

At the same time, however, it must be noted again that these two line research agencies have suffered disproportionately in the budget reductions proposed for fiscal 1971. This budgetary treatment tends to reinforce the view within the Commonwealth's departments that research is a marginal activity, likely to be the first area eliminated in any unusually tight fiscal situation. Visibility and viability may be opposing organizational strategies.

An act of Pennsylvania's legislature in 1949 created a special research and training center in mental health, the Eastern Pennsylvania Psychiatric Institute (EPPI).[5] The act further specified that the institute should be built in Philadelphia and have active affiliation with the city's five medical schools: Hahnemann Medical College, Jefferson Medical College, Temple University School of Medicine, University of Pennsylvania School of Medicine, and Woman's Medical College. The board of trustees for the institute was to be composed of three members from each of the five schools, and the fifteen-member body was to function as an administrative board. The institute was opened in 1956.

In 1967 the enabling act was amended to bring the institute more directly into the mainstream of the Commonwealth's mental health and retardation program. The board of trustees assumed an advisory role, and the Bureau of Research and Training in the Office of Mental

Health and Mental Retardation, Department of Public Welfare, was moved to the institute to facilitate application of the institute staff's scientific expertise to problems facing state institutions for the mentally disabled and the developing community mental health centers. This bureau is now responsible for coordinating mental health and mental retardation research and training programs throughout the Commonwealth.

The research departments of EPPI conduct basic and applied psychiatric research which supports its education and clinical services. The institute is responsible, in conjunction with the medical schools, for training individuals in all mental health disciplines. Graduate and medical students also receive research training and university staff conduct research projects within the institute. State appropriations to the institute which are used for research total approximately $1.3 million annually. The amount of basic research conducted is probably greater than in any other state agency, exclusive of the state universities and colleges (see Part II).

Like P-SEF and the Coal Research Board, the Eastern Pennsylvania Psychiatric Institute is given wide latitude in selecting which research projects it will conduct contingent upon its overall duties and the budget constraints determined by the legislature and governor.

B. Organization of Research Programs

Existing organizational arrangements do not necessarily focus attention on a department's research efforts. Departmental research

programs are organized across a broad spectrum of formal mechanisms. Formal research programs were found to exist in the following agencies:

1. Formal Research Programs
    1. Agriculture
    2. Commerce, including P-SEF
    3. Community Affairs
    4. Eastern Pennsylvania Psychiatric Institute
    5. Education
    6. Fish Commission
    7. Game Commission
    8. Health
    9. Highways
    10. Mines and Mineral Industries
    11. State Planning Board, including the Bureau of Topographical and Geological Surveys

Formal research programs have the following common elements: first, research is carried out within a distinct bureau or office in the agency, a line research unit, or an operations-related research unit. Second, the research unit appears as a line budget item or receives funds from earmarked sources. In all cases, the level of research expenditures for the period studied exceeded $150,000 a year and, in the majority of cases, was more than $500,000 annually. Third, program formulation and coordination is handled in part by a departmental research priorities committee, determined by management or statute. Excluding the State Planning Board, these ten agencies account for 75 percent of all research expenditures in the Commonwealth. Formal

research programs are thus considered to exist where there is a distinct research unit or source of funds that is primarily intended for the performance of research. Such administrative units of funding sources were always recognizable by the individual agency personnel.

Less formal research programs were found to exist in the following agencies:

2. Informal Research Programs

    1. Administration
    2. Board of Probation and Parole
    3. Civil Service Commission
    4. Forests and Waters
    5. Historical and Museum Commission
    6. Justice
    7. Labor and Industry
    8. Revenue
    9. State Police
    10. Public Welfare

Informal research programs may be characterized as follows: first, research is carried out on an intermittent and occasional basis by staff personnel whose major duties lie elsewhere. Second, money for research projects is scraped together from numerous sources and has rarely exceeded $150,000 annually per agency. Third, project priorities are established in a less formal manner through the appropriate bureau director and the department secretary, with the assistance of various staff personnel.

The informality of a research program is not necessarily indicative of lower quality output for an individual project. Some agencies are just beginning to formalize their research needs or to communicate the desire for more formal research programs, especially in the areas of criminal justice and correction. In other cases, the limited extent of a department's research activities may be attributable to the fact that research in its functional areas is regarded as the responsibility of another state agency or of the federal government.

Thus, informal research programs are those in which there did not exist a distinct administrative unit or source of funds primarily intended for research and which was immediately recognizable by the agency personnel. In general, informal research consists of intermittent problem-solving and occasional reports or activities which often border development, demonstration, program evaluation, and planning activities. These operations may be labeled staff-research units.

All other Commonwealth agencies either reported no research or their research activities were of such an intermittent and occasional nature that information could not be collected from agency personnel. Included in this category are the following agencies:

3. No Traceable Research Program
    1. Banking
    2. Insurance
    3. Military Affairs
    4. Property and Supplies
    5. Public Utility Commission

6. State

7. Treasury

C. Organizations for R & D

Two predominant types of research organizations are found within the Commonwealth. The first, the operations-related research unit, is found in those agencies characterized as having formal research programs. The second, the staff research unit, occurs in agencies with informal research programs or in subdivisions of agencies having operations-related research units. The third type of organization for research, the line research unit, is discussed in the following section.

Operations-related research units may exist as distinct bureaus or offices within a department (Education, Community Affairs) or as subdivisions of an operating bureau (Fish Commission, Game Commission). In either case, not all research activities in a department are necessarily found within the operations-related research unit. Typically, there will be staff research activities in other operating divisions where small to medium-sized research projects are conducted. Six bureaus in the Department of Education do some traceable research. Four bureaus in each of the Departments of Community Affairs, Commerce, and Health reported some research. Fragmentation of effort within and between departments results from (1) the variety of different functions performed; (2) a desire to make employment attractive to professional staff; and (3) funding at the federal level of various programs and projects.

Since federal grants may be on a one-shot basis or expectations are that federal funding levels will decline, staff research within operating divisions tends to be contract research. In this manner, state agencies avoid overstaffing in the face of possible declines in federal support.

Significantly, fragmentation is not indicative of research duplication within a department. On the other hand, it does create both departmental and intradepartmental coordination problems (see below). This problem aside, fragmentation may result in improvement in the allocation process rather than a misallocation of resources. Some particularly inventive research projects were found to be attached to operating divisions rather than to the established operations-related research units. By associating the project with the agency division which can best capture the full benefits of new knowledge, uncertainty is reduced and information loss is prevented. Thus, research which is general to the department's major responsibilities may be conducted in the research unit while research which is specific to an individual operating unit may tend to be conducted in that division.

Within the operations-related research units, there are distinct differences in the size, complexity, and funding sources for research programs. Certain programs are almost entirely contract research operations, such as the two line-research units, the Coal Research Board, and P-SEF. Included in this category are the research programs of the Departments of Agriculture, Community Affairs, and Highways and of the Game Commission. The other formal research programs either devote most of their funds to in-house research or plan to move

in this direction. Included in this category are the Departments of Education and Health and the Fish Commission. With the exception of the last agency, the research organizations which concentrate on in-house research have predominantly professional staffs. In-house research is thus viewed as one means of attracting competent professional personnel. Research in the Fish Commission requires a certain amount of capital investment, which may explain the choice of performer in this agency.

There are, however, other reasons for choosing in-house over contract research. Administrative discretion may be one explanation if, for instance, the head administrator desires a large staff. Several agencies stated that unsolicited contract research was too basic for their needs and that a shift had taken place toward solicited contract research or in-house research.

Also, once a research project is completed, the new knowledge may become a public good, unless protected by property rights. Since we are concerned here with public agencies, one might expect that these agencies would not be concerned that the information produced would disseminate beyond the area of intended application. However, the observed desire to restrict the amount of contracted research may reflect an actual desire to capture the full benefits, direct and indirect, of the knowledge produced.

Each research project may be viewed as an investment which will yield a flow of benefits over some long period of time. Conceptually, consultants would be used when the cost of contracting was less than the discounted present cost of hiring additional in-house personnel,

less any discounted indirect benefits derived from in-house research relative to contracted research.

The major indirect benefit would be that part of the new information produced by a research project would be possessed by the project personnel and thus would accrue to the agency over time. As a research unit grows in size, the net discounted cost of hiring additional personnel will at some point fall below the cost of contracted research. One would thus expect the following factors to be considered in attempts to hire additional research personnel:

1. The size of the future research budget.
2. The degree of commonality in future research projects.
3. Whether the research conducted is viewed as contributing to the public function.
4. The labor market for the type of research personnel required.
5. The uncertainty of hiring personnel of unknown quality relative to the uncertainties of contracting.

The role of research in the operations-related research units can be further illustrated by an example--the Department of Community Affairs. The powers and duties of this department include the following:

> To conduct general research for various units of local government on problems affecting community affairs in the field of municipal administrative management, comprehensive planning, municipal forms of government, state-local relationships, fiscal procedures and generally to do any and all things necessary as an aid to better local and area government and community development; and upon request of a specific political subdivision to conduct under contract mutually agreed upon, extensive and continuous

> research on general problems on local and urban government and analysis of specific problems of the political subdivision.[6]

In line with this duty, research in the Bureau of Research and Program Development deals mainly with local government operations. The bureau spends roughly $200,000 annually on contracted research and $50,000 annually on in-house research. In addition, research projects on mass transportation, urbanization, community recreation, housing, public employee labor relations, and manpower development are conducted in staff research units of individual operating divisions.

It is more difficult to characterize the activities of the staff research units. Many of them concentrate on collection and assembly of data (Welfare, Labor and Industry). As mentioned previously, several agencies are attempting to formalize their research needs. The role of research in the less formal programs can be illustrated by the activities of the Civil Service Commission. Within the commission a Division of Research and Special Projects has been established (September 1968) as an offshoot of the Division of Education. The main functions of the new division may be briefly stated:

1. Develop and implement programs to identify and obtain information on social science research which is applicable to personnel selection.

2. Perform personnel research to evaluate the effectiveness of current personnel selection methods, improve current methods, and develop new methods and techniques.

3. Encourage and assist other personnel selection research studies of value to the Commonwealth.

4. Perform special project assignments as directed by management.

In its first full year of operation (fiscal 1969), the division spent an estimated $20,000 on in-house research. This level of expenditure is typical of the absolute level of expenditure on informal staff research (under $150,000). Applied research is carried on if and when funds become available subject to internal management decisions. Staff research activities typically are closely related to program planning, review, and evaluation. The operations-related research units, on the other hand, pursue scientific work as a main program objective.

D. Line-Research Organization

Research programs in Pennsylvania are most highly organized in three line-research units--P-SEF, the Coal Research Board, and the Eastern Pennsylvania Psychiatric Institute--which operate within mission-oriented departments (Commerce, Mines and Mineral Industries, Public Welfare). Aside from administrative expenditures, P-SEF and Coal Research Board funds are devoted entirely to contract research. The Eastern Pennsylvania Psychiatric Institute includes in-house research, teaching, and patient care units. These agencies constitute organizational precedent for a comprehensive research program in the Commonwealth on a functional or departmental level. The major focus and objective of each agency is a substantive research program.

E. Program Formulation and Coordination

Central to research administration is the process of program formulation and coordination; through it agencies develop ideas or areas for research, establish funding priorities, and control the

progress and dissemination of the research results. Despite our attempts to gather complete information in this area, in many cases only a rudimentary description of the process of program formulation and coordination emerged. First, we sometimes spoke with personnel who were not closely associated with the program or project under discussion. Second, research in some agencies tends to consist largely of unrelated projects scattered over some fairly long period of time (especially true of those agencies or subdivisions which lacked formal research program administrations). This problem was again complicated by the fact that research expenditures are not counted as separate items in many department budgets. Indeed, we were informed several times that keeping track of research expenditures was tantamount to "counting paper clips." Even with these shortcomings, there is a pattern of departmental research formulation and coordination, and there appears to be an emerging structure for interdepartmental coordination.

Program Formulation and Coordination at the Department Level

The process of program formulation and coordination is most highly developed in the line research units and in the operations-related research units. The following coordinating committees exist in these units:

1. Agriculture--Research Committee (determined by statute
2. Community Affairs--Program Evaluation and Review Committee (administratively determined)
3. Commerce--Governor's Science Advisory Committee and Governor's Economic Advisory Committee (appointed by governor)

4. Education--Research Priorities Committee (administratively determined)

5. Eastern Pennsylvania Psychiatric Institute--Executive Committee (administratively determined)

6. Fish Commission--Pennsylvania Fish Commission (determined by statute)

7. Game Commission--Pennsylvania Game Commission (determined by statute)

8. Health--Research Review Committee (administratively determined)

9. Highways--Research and Development Advisory Group (administratively determined)

10. Mines and Mineral Industries--Coal Research Board (determined by statute)

The above list does not include the research programs in state hospitals. Program review in these institutions has not been explicitly accounted for in our study.

Typically, an administratively determined research review committee is composed of the department secretary and his executive assistants, the director of the research bureau and, on an ad hoc basis, the director of the bureau whose program may be involved in the research project under consideration. Management determined review committees are entirely composed of departmental personnel in contrast to the other committees, which include individuals outside of Commonwealth government on a formal or ad hoc basis.

The formulation and coordination of research priorities is most highly developed in the Department of Mines and Mineral Industries. The director of research and development receives suggestions for research areas from the coal industry (management and labor) and coal

users (steel, electric power) and solicits proposals from research agencies. Evaluation of the proposals and approval of the projects is carried out by the Coal Research Board in conjunction with the director. He then prepares the contracts, monitors the research in progress by monthly visits and written summaries, and is responsible for dissemination of final reports. Rapid transfer of research findings into operational programs is made possible by the department's possession of readily available funds, which were provided by a 1967 bond issue. The department is in the unique position among state agencies of being able to get funding on research relevant to its problems and then being able to fund the capital equipment necessary to implement these findings without requesting a budgetary appropriation.

Within the other Commonwealth departments more diverse methods of generating research ideas exist. Proposals from operating divisions and the department secretaries were cited as the more frequent sources of ideas. Occasionally the governor's office or the legislature will request special studies. Various private and public groups may be a source of research ideas. As already mentioned, there has been a shift away from funding unsolicited proposals with the result that university researchers are probably less involved in program formulation than they were previously.

A second avenue for program formulation and coordination takes place through the budgetary review process. The research units in Commerce, Community Affairs, Education, Health, and Mines and Mineral Industries appear as line items in the budgets. These research units are therefore scrutinized by the department secretary, the governor's

office, and the legislature.[7] Some agencies receive earmarked general funds (Fish Commission, Game Commission) or earmarked research funds (Agriculture, Highways) and are therefore less subject to external scrutiny.

In the less formal research programs, formulation and coordination of research projects are generally achieved on the basis of informal decisions between the appropriate bureau director and the department secretary, with the assistance of various staff personnel. Occasionally ad hoc committees are formed which may include personnel from other Commonwealth departments which have a close interest in the research project (see below). Legislative or executive review of these projects is not possible since the budgets of the operating divisions do not include separate estimates of the research; instead these items are lumped in with the general estimates.

Interdepartmental Program Coordination

Coordination of research programs on an interdepartmental basis can take place directly through interdepartmental committees or indirectly through the executive branch and legislature. For the most part, interdepartmental committees have been ad hoc, set up for the purpose of approving the research design as well as preventing duplication of efforts. Such committees are found in the functional areas of health, highways and mass transportation, recreation, and education. On a more formal basis, the Water Resources Coordinating Committee oversees the activities of the Commonwealth agencies which are involved in administering water-related programs. The Health Department is in

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the process of establishing a general committee and several regional committees to adopt statewide research priorities to local needs for research.

More could be done in the way of establishing interdepartmental coordinating committees, especially in the functional areas of health and natural resources. Substantial amounts of federal funds for research in these areas tied to various programs have created an undue amount of research fragmentation within the Commonwealth. Such committees could prevent duplication of research efforts, work out clear lines for a division of labor among departments, coordinate complementary research programs, and engage in joint planning of research. Similar committees might also be considered for socioeconomic data collection, educational activities, and economic development.[8]

Clearly, interdepartmental committees are no substitute for line responsibility in the conduct of research. However, on an advisory basis they can prevent duplication of effort, establish priorities among competing projects, provide individual departments with expert advice, and, most importantly, identify possible common relationships and spillover effects. There are definite benefits to be derived from a certain amount of fragmentation and interagency competition--duplication to some. But where there are fewer uncertainties or more crucial interdependencies, a higher degree of centralization could bring fewer costs and more gains.

Some degree of formal coordination of research is currently provided through the Office of Administration and the State Planning Board. Within the former, the Bureau of Systems Analysis conducts an

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annual survey of all agencies within the Commonwealth to determine research needs which might provide subjects for special analytic studies. Proposals received in this manner are then analyzed and evaluated by the bureau on the basis of twelve variables, including availability of qualified staff, relevance of the project to other agencies, and current research or applicable findings elsewhere. A numerical weighting system is used to rank each project and the ordered list of projects is then submitted to the secretary for approval.

The Office of Administration has also been authorized to review all contracts for consultant services which are to be financed either wholly or partially with state funds. The requirements of the administrative directive (see Appendix B) include:

1. The Bureau of Systems Analysis shall determine whether the services requested can be performed by Office of Administration personnel or other Commonwealth personnel.

2. The agency requesting the services of an independent consultant shall form an evaluation committee and establish criteria to evaluate the proposals with assistance from the Bureau of Systems Analysis.

3. The contracting agency shall furnish the Bureau of Systems Analysis with a copy of the final report of all consultant studies.

As a result of this administrative directive, the Bureau of Systems Analysis in the Office of Administration exercises limited central control over the process of research formulation and coordination.

Concurrent with the implementation of a PPB system in the Commonwealth, the Office of Administration will have somewhat greater control over the entire spectrum of Commonwealth activities, including

research. Conflicting reports were received from various agencies on exactly how the PPB system would affect their research program. On the one hand, it was reported that the PPB system would permit easier information retrival so that even those departments with less formal research programs would be able to report complete budget and expenditure data. On the other hand, it was noted that since the PPB program categories do not explicitly include research, it would be more difficult to justify research projects. A program subcategory such as "improved and new programs in social development" might be appropriate. The PPB system will place a premium on collection and assembly of basic impact data and should consequently foster research and evaluation activities. Since the PPB system is new, somewhat controversial, and not fully implemented, some confusion about its exact requirements and use is understandable.

A third area of indirect central coordination of research programs takes place through the State Planning Board. In developing a comprehensive state plan and information system, the board coordinates, reviews, and serves as a liaison for various department programs. Its responsibility for coordinating activities of other state departments appears to have been enhanced by the Intergovernmental Cooperation Act and recent directives (e.g., A-95) of the U. S. Bureau of the Budget. Under these new policies, a state agency must submit its proposals for certain types of federal funding to the appropriate state planning agency to insure consistency of the department's request with the state plan. The exact nature of this review, initiated in 1969, is unclear. Both state and federal line agencies are apparently apprehensive about

this arrangement as it threatens to interpose a new review agency between federal and state agencies, which might over time have developed mutually satisfactory working relationships. An extension of this policy to all federal grant programs could place the State Planning Board in a position of reviewing (with implied powers of disapproval) all federal-state programs, including those that provide research support to state agencies.

Interstate and Federal Influence on Program Coordination

Since a substantial portion (about 30 percent) of Commonwealth research is financed by the federal government, it is important to identify the ways in which federal agencies and interstate instrumentalities have affected program development and coordination. The federal government, in its role as a grantor of research funds, exercises control over the directions taken by Commonwealth research agencies. While state agencies may not consciously design research projects to obtain federal funds, they are usually aware of which type of state-initiated or endorsed projects are most likely to be funded.

In the areas of agriculture, natural resources, highways, and health, the federal government plays an important role in planning and coordinating research activities at various levels of government. While the Agricultural Extension Service is often suggested as a model for implementation and dissemination of basic and applied research,[9] in actuality state agencies play a small role in its research program. Federal agricultural research funds are funneled mainly through the

land-grant universities, with little direct input from the states. Actual working relationships are, in fact, much closer due to an interlocking of personnel from The Pennsylvania State University's experiment station, and the state Department of Agriculture. Federal agricultural programs carried out in cooperation with the state department are mainly for marketing reports and inspection services. Significantly, placing the experiment station outside the state agencies has probably facilitated cooperative regional research projects.

In natural resources, the U. S. Department of the Interior serves an interstate coordination function. In at least one program, research and development projects judged local in nature are funded on a 50-50 matching basis; projects judged regional or greater in scope are fundable on a 75-25 federal-state basis. Several of the research projects within the Pennsylvania Fish Commission have been regional in scope.

In the area of highway research, the National Highway Research Board and Research Correlation Service within the National Highway Research Council serves as a clearinghouse for research groups and keeps public and private agencies informed of highway research throughout the nation. Research projects are also carried out under the council's auspices. State highway departments, acting through the American Association of State Highway Officials, propose studies to the council which are financed through a formula allotment of highway monies. State highway departments have also occasionally joined in ad hoc cooperative research projects on problems of a regional nature. Pennsylvania is presently engaged in such a project with other northeastern states on the

properties of curved girders. The Portland Cement Association and the Asphalt Institute also provide basic research information to state highway officials, who then must decide on the applicability of these findings to the state's highway needs.

With regard to health research, certain federal grants require that a state plan be submitted to the Office of Comprehensive Health Planning in the U. S. Public Health Service. This provision is designed to coordinate programs of state and local public health services. A state plan is now required of almost all Commonwealth departments and subdivisions as part of federal assistance procedures.[10] While these plans tend primarily to describe the present status of a department's programs, they do in certain instances give some definition for program plans beyond the project under consideration.

Finally, there is evidence of interstate and federal influence on Commonwealth research activities in certain regional commissions, most importantly the Appalachian Regional Commission. The Appalachia Division of the Pennsylvania Department of Commerce, assisted by the State Planning Board and seven regional development district councils, prepares an investment plan for the Appalachian region of the Commonwealth. The division's research program has been oriented toward improving the infrastructure necessary for economic development: transportation, pollution control, community services, health and education facilities. Certain ideas for research and development projects have diffused across state boundaries, and information from research projects can be disseminated through the Appalachian Regional Commission.

Other regional commissions could conceivably serve as interstate clearinghouses for research ideas and information. Pennsylvania contributes financially to the following interstate instrumentalities:[11]

1. Commission on Interstate Cooperation
2. Council of State Governments
3. Interstate Oil Compact Commission
4. Ohio River Valley Water Sanitation Commission
5. Interstate Commission on the Potomac River Basin
6. American Council on Intergovernmental Relations
7. Atlantic States Marine Fisheries Commission
8. Great Lakes Commission
9. Interstate Agency on the Susquehanna River Basin
10. Potomac River Basin Advisory Committee
11. Delaware River Basin Commission

Cooperation among the states in solving problems which transcend state boundaries is not new; most of the above commissions date from the 1940's. It remains to be seen, however, if they can play an important role in coordinating research efforts.

Finally, some informal interstate cooperation, or at least information on what is being done elsewhere, is a by-product of professional association meetings attended by state government officials.

FOOTNOTES

[1]F. N. Cleaveland, Science and State Government (Chapel Hill: The University of North Carolina Press, 1959), p. 97.

[2]Act 416 (1967 Session), amending P.L. 177, Section 2503-B.

[3]See Pennsylvania Department of Commerce, Science for Society: New Help for Domestic Problems (Harrisburg, Pa., undated).

[4]Act 651 (1956 Session), amending P.L. 177, Section 1906.

[5]See Welcome to the Eastern Pennsylvania Psychiatric Institute (Philadelphia, Pa., undated).

[6]Act 582 (1965 Session), Article XXV-C, Powers and Duties of the Department of Community Affairs, its Departmental Boards, Bureaus, and Agencies, Section 2501-C, pt. E.

[7]Less formal research units which also appear as line items in the budget include the Historical and Museum Commission, Labor and Industry, and the Public Utility Commission research bureaus.

[8]See Cleaveland, op. cit., p. 113.

[9]For example, see R. R. Nelson, M. J. Peck, and E. D. Kalachek, Technology, Economic Growth and Public Policy (Washington: The Brookings Institution, 1967), pp. 198-209.

[10]See Pennsylvania Office of Administration, Digest of Federal Assistance to Pennsylvania (Harrisburg, Pa., May 1970).

[11]See Commonwealth of Pennsylvania, Executive Budget, 1969, Vol. II, General Fund (Harrisburg, Pa. undated).

CHAPTER VI

INTERGOVERNMENTAL AND UNIVERSITY RELATIONS

Within the last twenty-five years there have been significant changes in "notions of federalism based upon the restrictive concept of exclusive spheres of activity for each level of government."[1] Federal government contracts and grants have created a vast network of contractual relations which vitiate any rigid distinction between state and federal affairs or between public and private affairs. The contracting-out and delegation of the execution of government programs have altered the basic nature of the public sector and led some observers to speak of a "new federalism" or "federalism by contract."[2] Some praise these arrangements as advancing the fundamental ability of governments to govern,[3] while others condemn the conversion of the states and private firms into veritable agents of the federal government.[4]

If these contractual arrangements make our political and economic system more flexible, they also complicate the problem of decision-making in the formulation and operation of government programs. Not only must choices be made between expenditures on specific programs (e.g., highways, health, education), but government officials must also select the performer or mechanism through which the program

objectives will be achieved.[5] No longer is the question simply a matter of which existing or new federal-state agencies shall be involved, but whether expertise outside of government agencies should be utilized and to what extent. So long as a single mechanism was used, the problem of rational choice of mechanisms did not exist. Not unexpectedly, research administrators we interviewed often expressed concern and frustration over the complexity of the environment in which they had to make decisions.

A major problem facing each state is that of adaptation to the actual or prospective changes produced by technological change which originates through federal sponsorship of R & D. Acceptance by state and local officials of federal funds does not necessarily guarantee effective programs in a dynamic environment. Likely increases in the flow of federal funds to states and municipalities--through whatever variant of revenue-sharing is adopted--may have to be matched by changes in the structure of the political agencies accepting these funds.

These problems are no less significant in Pennsylvania than they are in other states. Commonwealth officials must determine what kind of relationships should exist between the Commonwealth and other agencies, public and private, and how these relations should affect research programs and activities. Such questions are discussed in this section.

A. The Federal Government and Commonwealth Research Programs

A previous chapter reviewed and described how federal agencies aid coordination of research programs within the Commonwealth and between Pennsylvania and other states. Further relationships between state and federal programs are explored here.

One link between state and federal research programs is the exchange of information on research needs and problems. Such data exchange may take place through national organizations such as the previously mentioned National Highway Research Council. In the area of forestry management, the U. S. Forest Service screens new programs through the National Association of State Foresters and the personnel in the State and Private Property Division of the Forest Service. Similar exchanges of information exist in various problem areas of water pollution, flood control, health, and education.

A second type of relationship is the cooperative federal-state research project, examples of which are found in Pennsylvania. In agriculture, the joint federal-state Crop and Livestock Reporting Service gathers and disseminates information. Program services are provided by federal personnel; the state contributes a partial financial reimbursement. Other inspection, survey, and control programs are also administered on a cooperative basis. The Pennsylvania Department of Agriculture has also financially supported a research study of soil erosion and stream sedimentation control administered by personnel of the U. S. Geological Survey.

The U. S. Department of Health, Education, and Welfare has provided numerous services to the Research and Special Projects

Division of the Pennsylvania Civil Service Commission, but no federal-state cooperative research projects have been undertaken. In addition, each state or local agency which employs the commission contributes toward its operation and indirectly to the research programs. Thus, state agencies which are totally funded by the federal government, such as the Bureau of Employment Security, contribute federal funds to the commission.

The Pennsylvania Department of Forests and Waters participates in several joint projects. The Bureau of State Parks cooperates with the U. S. Corps of Engineers in the construction of dams and reservoirs. Under current lease agreements, the bureau must provide assurance that Pennsylvania will operate and develop a completed facility to meet user demands. The Bureau of Engineering cooperates with federal agencies in projects relating to areas such as soil conservation, flood warning and control, geological surveys, water resources planning, and dam construction. The basic dichotomy of agency representation versus cooperative team effort is usually resolved by compromise in these projects. Under the Water Resources Planning Act, the states are taking a more active role in comprehensive water and related land resources planning. The Bureau of Engineering has also contributed state funds to the U. S. Geological Survey for a research study of reservoir ecology. Finally, the Bureau of Forestry relies, in part, on the research experiment stations of the U. S. Forest Service for research information. The bureau contributes $4,500 annually to the Northeast Forest Experiment Station for a study of revegetation of strip-mine spoil banks.

In Pennsylvania's Department of Labor and Industry, the research and data collection program of the Bureau of Employment Security is supported by federal funds, originating primarily in the U. S. Department of Labor. The bureau has also performed special studies for federal agencies on a contractual basis. Federal agencies such as the Bureau of Labor Statistics and the Department of Commerce have suggested and assigned projects or pilot studies in the state bureau's Division of Research and Statistics.

The Coal Research Board in the Commonwealth's Department of Mines and Mineral Industries has financed federal projects, with matching state appropriations, of relevance to Pennsylvania. Necessary federal funds were not available to the extent required by the projects in question.

The third type of relationship between federal and state research programs has to do with the granting of financial aid. Federal funding is quantitatively important in the functional areas of health, economic development, transportation, and education; all other program categories receive smaller absolute amounts of federal funds for research.

Federal funds may be distributed in several different ways. An important source of funds to state agencies are the grants-in-aid which are attached to specific projects. For example, the Pennsylvania Fish Commission receives federal funds administered by the U. S. Bureau of Commercial Fisheries for research and development projects to restore, manage, and/or improve aquatic animals and plants available or potentially available for harvesting with the primary intent of

commercial usage. The contract between the commission and the Bureau of Commercial Fisheries is called a project grant and, in this case, the commission is reimbursed upon completion of the project.

Almost all federal programs which have involved research in the Commonwealth have been project grants. While the exact administrative details vary from program to program, such grants ordinarily call for the state agency to propose projects and federal officials to review and pass on the qualifications of the projects for support. Various stipulations with regard to documentation, length, and time phasing of assistance must also be followed.[6]

An alternative to the project grant is the formula grant, which appears to have somewhat less rigid requirements for assistance. For example, the Pennsylvania Department of Highways receives up to 1.5 percent of federal construction funds for research, development, and planning. To qualify for these funds the Bureau of Materials Testing and Research, in conjunction with the Bureaus of Highway Planning and Statistics, Advance Planning, and Traffic Engineering, submits to the U. S. Bureau of Public Roads an annual planning and research work program. Research projects in the work program are funded on a 75 percent federal-25 percent state basis, although no matching funds are required for projects requested by the Bureau of Public Roads.

The Pennsylvania Crime Commission receives and administers state and local funds under the Omnibus Crime Control and Safe Streets Act of 1968. Funding is based on a formula determined by population. For planning projects, the U. S. Law Enforcement Assistance Association will pay up to 90 percent of Commonwealth operating costs

dependent upon the appropriations level. A state plan for criminal justice is required to qualify for this assistance.

The Department of Public Welfare prepares a state plan in order to qualify for formula improvement and demonstration grants under the Older Americans Act of 1965, subject to approval by the Administration on Aging, Social and Rehabilitation Service in the U. S. Department of Health, Education, and Welfare. The formula is based on the elderly population and the level of appropriations and is administered in Pennsylvania by the Bureau of Community Consultation, Office of Family Services.

While not exactly block grants, formula grants do afford greater opportunity for central coordination of a department's research budget. Use of this technique should increase the continuity the research programs, relative to the often sporadic project grants. Formula grants are promising means of providing more continuous support for state research programs. Real opportunity exists for the state to determine its research needs under these arrangements within the broad constraints of various federal formulas.

A final variation of the federal grant system is the categorical grant to support research in areas such as physical health and mental health. Typically, these grants aid research on diseases such as cancer, cerebral palsy, and cardio-vascular disorders. While somewhat broader in scope than the project grants, they do not allow a researcher full freedom to pursue basic investigations unless they are directly tied to the category in question.[7] Similar categorical grants are made by the Commonwealth to the state hospitals and mental health institutions to support clinical and laborabory studies.

Pennsylvania now has available a Digest of Federal Assistance programs in the Commonwealth, including those which support research. Surprisingly, there is no generally accepted federal listing of all grant-in-aid programs, despite the fact that federal aid accounts for 18 percent of state and local revenue. Miss Rochelle Stanfield, Assistant Director for Information and Research, Washington Office of the National Governor's Conference, states that "federal aid today is a nonsystem of fragmented, overlapping categorical grants . . . [and] the key to rationalizing the process is central state coordination."[8] This will require that the governor and legislature exercise greater control over state participation in grant programs in close cooperation with department secretaries and bureau directors. To date, research personnel feel isolated from the legislature, and the states are not likely to play an important role in the design and structure of the federal grant system in this atmosphere. The National Science Foundation is currently engaged in a program whose purpose is to increase the involvement of state legislators in science policy.

The structure of relationships between federal and Commonwealth agencies has already been described. What, however, is the effect of these relationships on the Commonwealth's ability to produce through research new and improved operating programs? Some observers regard cooperation between federal and state authorities as far from satisfactory,[9] while others fear that establishment of "good" cooperative relationships may result in the loss of state independence. Don Price, in a provocative note, suggests that "the louder you hear a group of state governments or private corporations complain about

federal control, the more evidence it is that they are relatively independent of it."[10]

There are, of course, drawbacks from the state's standpoint to federal grant programs. Murray Weidenbaum lists the following as possible circumstances involving loss of state control of programs:

1. Federal grants may have a distorting effect on the expenditure pattern of state and local governments.

2. Federal departments may have a substantial degree of control over those portions of a state's own budget which are devoted to matching the federal funds.

3. Federal departments can require advance approval of a state's operating as well as its expenditure plans before disbursing the grant money.

4. Some programs provide for extensive supervision by the federal government.[11]

There are other problems with the current federal-state arrangements. Federal programs may be terminated abruptly and end a well-established state program which may be serving a real need. It is then up to the state to determine if it has the financial resources to continue the program. The State Technical Services Act of 1965, enacted to provide a flow of technological information to business firms, was terminated by the federal government in 1970 despite the fact that the program was not considered "seed money." Pennsylvania's Technical Assistance Program (PennTAP) will apparently be continued for at least fiscal 1971 without federal support.

Another problem involved with current arrangements is the inability of the state government to attract competent personnel to staff various research projects.[12] Since Commonwealth wage scales are not fully competitive with the federal scales (and, we suspect,

with those of private industry), this may restrict the quality of research programs within the Commonwealth.[13] In a similar vein, increasing technical sophistication is needed for states to obtain grants under federal programs. Those states which can submit well-thought out and technically sound proposals are likely to gain greater shares of federal project grants.[14]

The problems of nonappropriability, zero marginal cost of use, uncertainty, and indivisibility of knowledge, discussed in Chapter II, exist for every state government. Thus, significant obstacles must be overcome if all states are going to benefit under current research grant procedures. In particular, there may be little reason for an individual state government to engage in a federal-state supported research program if the results of the program are to be widely distributed to other public and private bodies. Federal contracting is required in this case, but this may mean that each state is given a piece of the federal pie. Aside from the obvious possibility of duplication, it is likely that there is some minimum scale of operation required for an efficient program.[15] Where scale economies are significant and where undue fragmentation appears likely, concentration of a research program at the federal or regional level is desirable. The operating program may remain with the states.

To summarize, current federal-state relationships create a number of problems in the operation of research programs. First, in federally funded projects there is often a loss of control on the part of the state. (This seems less likely where there exists a national organization such as the National Highway Research Council or the

National Association of State Foresters described previously.) The Agricultural Extension Service, often suggested as an ideal model for intergovernmental cooperation, in reality gives the state agencies only a small role in the area of agricultural research. But this program may have stimulated research applicable to several geographic areas.

Second, federal financial support may be terminated abruptly, with no feasible alternative available. State agencies guard against termination of federal programs by contracting out research projects.

Third, state governments are likely to be understaffed in terms of qualified research personnel. In addition to low state salaries, the lack of higher education facilities in Harrisburg hinders the Commonwealth in attracting competent personnel.

Fourth, state programs are apt to be restrictive in scope due to the nonappropriability of information produced, economies of scale in operations, indivisibility, risk, and uncertainty. These problems are best overcome by regional structures for research. Pennsylvania contributes financially to a dozen interstate compacts, some dating from the 1940's. But over half of these interstate commissions are concerned with water resources, and few are involved in coordinating research.

There is little doubt that Commonwealth agencies desire to be involved in federal programs, and there is evidence that federal agencies actively encourage such involvement. However, it remains to be demonstrated how effective current structural arrangements are in producing viable and effective state research programs. Among the

possible changes often discussed are consolidation of the hundreds of federal grant-in-aid programs into a limited number of major substantive areas and the use of block grants, tax credits, and other less stringent means of revenue sharing. In addition, greater use of interstate and regional instrumentalities has been proposed. Pennsylvania's participation in such commissions has been described elsewhere.

B. Dissemination of Research Results

The processing and distribution of the results of research activities appears to be a particularly difficult problem in some research programs. This stems from the fact that many research reports are aimed at or consumed by a diverse audience, including the executive branch and legislature, government officials at all levels, the lay public, and the scientific community. No one research report is likely to satisfy all these groups with their differing backgrounds and interests. Research results need to be distributed by multiple methods and in multiple forms in order to reach each group effectively.

The Departments of Education and Highways do employ varied dissemination methods. In the Department of Education, research results may enter one or more of the following dissemination procedures:

1. Final reports of completed research are available to all groups and are sent to each chief school administrator and education development center in the Commonwealth. A Putting Research into Practice (PREP) report is also prepared.

2. Research coordinating unit newsletter and Quarterly Bulletin for Vocational Education.

3. The Pennsylvania Education Bulletin.

4. Completed Research Projects list published by the department, with a brief description of each project.

5. Pennsylvania's Abstracts of Research and Related Materials in Vocational Education (PARM).

6. Most research studies enter the national Educational Resources Information Center (ERIC) system.

Research findings from the Department of Education may also reach interested groups through various summary and retrieval systems and professional journals. In addition, a major part of the department's research program has been aimed at disseminating information on educational practices by publishing annotated bibliographies and constructing retrieval systems. An example of the latter is the Pennsylvania Retrieval of Information for Mathematics Education System (PRIMES).

In the Department of Highways, a major effort has been made to disseminate research results and findings. The Bureau of Materials Testing and Research publishes a research manual which outlines the department's procedures for project selection, review, and authorization. In particular, initial selection of research projects is in terms of the stated needs of operating units. Research findings from contract and in-house research are received by the bureau and transmitted to the appropriate persons in the relevant operating units. In addition, a research implementation officer has been designated for each central bureau office. As mentioned above, several national organizations disseminate research information obtained in Pennsylvania and other states.

Many Commonwealth research reports are published and released on a limited or selective basis to avoid the costs involved in widespread publication and distribution. This is felt to be justified

when, as is often the case, the research is considered to be directed at a limited audience. Although this may be so, this policy impedes the flow of information to others who might indeed be interested in a particular project. The Commonwealth should consider publishing an annual summary of research publications to be made available to all interested parties. This publication would supplement such indexes as the Monthly Checklist of State Publications, Pennsylvania Index to Statistical Sources, Pennsylvania Directory of State Publications, and the Public Affairs Information Service index. Publication of a yearly summary of research projects would improve information dissemination and also increase the sense of professionalism attached to Commonwealth research programs.

If state agencies are to play a larger role in science policy, attract the sort of expertise needed for such a role, and place research on a solid foundation, it is essential that research findings be disseminated widely, if necessary on a face-to-face basis. The most notable instances of research results being translated into implementable projects have occurred when a direct capital investment plan could be tied to the results of the research program. Examples are the Coal Research Board and the Appalachia Division of the Pennsylvania Department of Commerce.

C. The University and Commonwealth Research Activity

If it is true that federal-state relationships have improved over time, it is equally true that state-university relationships have progressively deteriorated. If state officials view federal-state

relationships as a two-way flow of money and services, it is also evident that they view state-university relationships as a one-way flow of money. Again, frustrations born of multiple mechanisms lie at the heart of the problem. At one time, the goal of the university was a simple combination of teaching and basic research in academic disciplines. Today, the academician may be simultaneously involved in teaching, basic and applied research, and consulting for public and private agencies. Moreover, applied research problems rarely fit neatly into traditional disciplines, and numerous interdisciplinary research groups now exist.

It is clear from our discussions with Commonwealth research personnel that many of them are dissatisfied with the quality of the product produced by university researchers under state contract and with existing contractual arrangements. The gist of the criticisms is that (1) university research is too basic to be useful; (2) university research is often farmed out to graduate students who lack adequate training; (3) university contract research is rarely completed on time; and (4) it is not always possible to institute cancellation clauses against a university.

Concurrent with growing dissatisfaction with university research have been a decline in funding of unsolicited research proposals. While unsolicited proposals are still funded by state agencies, the number, and certainly the desire to fund such proposals, has declined. The basic reason given is that unsolicited proposals are too basic to be useful. However, this can be looked at from a different viewpoint. Contracting agencies, like most individuals, may be

more comfortable when there is some opportunity for comparison and choice. Unsolicited proposals may give the contracting agency little opportunity for comparison unless the solicitor and his proposal are familiar subjects. In addition, the contracting agency is now faced with the problem of convincing the Office of Administration that unsolicited proposals need not be placed on bids.

The alternative of putting proposals or problem statements out for bid is not without certain ethical problems. A vendor's research ideas may be incorporated in the final contract even though it is not granted to him. While most researchers probably recognize this possibility, some explicit statement of policy from the Office of Administration is desirable in this connection.

Despite existing dissatisfaction with university research, strong relationships still exist between certain agencies and the universities. The Pennsylvania State University's strong traditions in agriculture, engineering, and the physical and life sciences have led to strong contractual relationships in certain Commonwealth departments, such as Agriculture, Mines and Mineral Industries, Highways, and the Fish and Game commissions. The University of Pennsylvania, with strength in the social sciences, has been more closely involved in the functional areas of education, welfare, police protection and correction, and financial administration. Other higher education institutions in the Commonwealth are less heavily involved in state research, although the University of Pittsburgh's studies in the area of transportation are notable.

Roughly half of all Commonwealth research is conducted through the use of in-house facilities and personnel. The remainder is split

fairly evenly between the universities and other contracting organizations. Existing contractual arrangements have not changed drastically, at least within the last four years. As a result, it is difficult to accept the notion that the universities have, in general, become more isolated from the responsibilities and duties of state government in the area of research.

The alternative to university research is contract research with profit and nonprofit firms. Profit-making corporations, such as General Electric, Westinghouse, and Dravo, are more likely to be active in state research when a new product is involved. Certain consulting firms such as the Pennsylvania Economy League and Better Government Associates exist as quasi-public institutions for research and consultation on state problems.

D. The Scientist and the Commonwealth

Our discussions with research personnel in the Commonwealth were not oriented to personal feelings and opinions but rather to the structure, policy, and method of in-house and contract research. Yet one cannot speak personally with more than fifty individuals without gaining some impressions of their work environments.

There does exist in the Commonwealth a constrained sense of professionalism among research personnel which is strongest in the "hard" (physical) sciences and weakest in the "soft" (social) sciences. Professionalism is constrained in the following senses: first, research personnel feel their responsibilities are regarded as expendable by the department secretary, the executive branch, and the legislature; second,

research is further downgraded by its short-term and intermittent nature; and, third, the research programs are definitely isolated with respect to the legislature.

The sense of professionalism among Commonwealth research personnel is strongest in the hard sciences with regard to other individuals in the Commonwealth, federal agency personnel, and regional and national professional organizations. Our conjecture is that individuals in the hard sciences are also better equipped and have greater desire to play the game of grantsmanship than are most persons involved with the soft sciences. The professional group may serve as a clearinghouse for and coordinator of research projects. The great danger is that the scientist will identify more closely with his professional group than with state government.[16]

FOOTNOTES

[1]F. N. Cleaveland, Science and State Government (Chapel Hill: University of North Carolina Press, 1959), p. 120.

[2]D. K. Price, Government and Science (New York University Press, 1954).

[3]P. F. Drucker, "The Sickness of Government," Public Interest, No. 14 (Winter 1969), p. 17.

[4]W. F. Adams, "The Military-Industrial Complex and the New Industrial State," American Economic Review, Vol. 58, No. 2 (May 1968), pp. 652-665.

[5]M. Weidenbaum, The Modern Public Sector (New York: Basic Books, 1969), p. 5.

[6]See Pennsylvania Bureau of the Budget, Digest of Federal Assistance to Pennsylvania, May 1970.

[7]Cleaveland, op. cit., p. 125.

[8]R. L. Stanfield, "State Coordination of Federal Grants-in-Aid," State Government, Vol. 42, No. 3 (Autumn 1969), pp. 170-178.

[9]C. P. Haskins, The Scientific Revolution and World Politics, (New York: Harper and Row, 1964), p. 27.

[10]Price, op. cit., p. 90.

[11]Weidenbaum, op. cit., pp. 118-120.

[12]See E. S. Muskie, "Manpower: The Achilles Heel of Creative Federalism," Public Administration Review, Vol. 27, No. 2 (June 1967), p. 193.

[13]An additional note is the lack of higher education facilities in Harrisburg which is often mentioned as a drawback in attracting certain types of research personnel. In Appendix C, the Commonwealth's wage scale for research and research oriented personnel is presented.

[14]H. M. Sapolsky, "Science Advice for State and Local Government," Science, Vol. 160, No. 3825 (April 19, 1968), p. 284.

[15]Ibid.

[16]Cleaveland, op. cit., pp. 144-145.

PART II

DEPARTMENTAL RESEARCH ACTIVITIES

Office of Administration

Research within the Office of Administration is supported by General Fund appropriations. Conducted in each of the department's main divisions, research activities are of three general types. One relates to general questions concerning the internal management of the state's operations. Included here would be the projects of the Financial Management Bureau--which focus on the development of financial control procedures--and those of the Bureau of Management Information Systems, which center on the development of information systems internal to the state's operations. A second type, concerning questions relating to manpower recruitment, administration, and planning, includes the activities of the Standards and Research Division, the Classification and Pay Division, and the Manpower Planning Division. The third type of research deals with budgetary and efficiency questions extending to all phases of the state's operations. The bureaus involved are Budget and Systems Analysis.

In-house research expenditures within the department rose from an estimated $32,000 per year for fiscal 1966 and 1967 to $112,000 per year for fiscal 1968 and 1969. This increase resulted from (1) the addition of the responsibility for special analytical studies within the Bureau of Program and Management (which was then renamed the Bureau of Systems Analysis); and (2) the creation of a Manpower Planning

Division within the Bureau of Personnel Administration. Although no direct estimate is available on contracted research prior to 1968, it is believed that expenditures along this line were negligible during this period. Contracted research since 1968 has amounted to $40,000. (This figure does not include a $315,000 contract of the Institute for Public Administration at The Pennsylvania State University for the development and implementation of PPBS for the Commonwealth.)

The Bureau of Systems Analysis, created in 1968, has been assigned the task of carrying out special analytic studies. Its research is directed at providing answers to the secretary of the budget, and through him the governor, on the effectiveness of existing state programs, and on questions relating to various aspects of state programs which cannot be provided for by other departments. Its efforts have generally involved long-range forecasting, occasionally in conjunction with other departments. The bureau is seen as having a dual function: (1) to provide information to the secretary of the budget as described above; and (2) to serve as a general research facility to assist other departments in certain types of research.

Each bureau determines its own research needs and projects, subject only to approval of the bureau head and the secretary of administration. Project selection is more formally organized in the Bureau of Systems Analysis. There is an annual survey of all agencies within the Commonwealth to determine research needs which might be subject to special analytic studies. Proposals received in this manner are then analyzed and evaluated by the Bureau of Systems Analysis on the basis of twelve variables, which include such factors as availability of

qualified staff, relevance of the project to other agencies, and current research or applicable findings elsewhere. A numerical weighting process is used to evaluate and rank each project. The ordered list of projects is then submitted to the secretary of administration, who uses these rankings to determine which projects the bureau will undertake.

The decision to conduct either in-house or contracted research is based on three factors: (1) the bureau's existing in-house capabilities, coupled with the desire to permit the bureau's staff to develop research skills; (2) administration interest in a project; and (3) availability of funds for contractual research.

Formal control procedures exist for the management of in-house studies done within the special Analytical Studies Section. In other bureaus of the department in-house work is considered to be under the routine supervision of the individual bureau heads. Contracted studies are continuously monitored by the Management Studies Division. In addition, the department has recently been charged with overseeing the research activities of other departments.

The department's expenditures on R & D are determined by the funds appropriated by the legislature and the availability of staff. Interestingly, the bureaus regard the limited number of qualified staff as until recently having been the main constraint on the department's research activities. In all likelihood, the department's research activities will be expanded as part of the present attempt within the Commonwealth to incorporate into its operations program-planning and cost-effectiveness analysis.

The results of the department's studies, whether performed in-house or on a contractual basis, are generally distributed only within the Office of Administration and to those state agencies which are involved in the project or whose programs would be affected by the study.

Department of Agriculture

Research support in the Department of Agriculture is derived mainly from the Harness Racing Fund; no specific appropriation for research comes to the department from the state's General Fund. One-fourth of the net harness racing receipts are given to the Pennsylvania Fair Fund, from which payments are made to the more than eighty county and agricultural fairs held throughout the state for premiums and prizes and to support various youth groups, such as Future Farmers of America. Part of the Fair Fund--nominally 50 percent or $400,000, whichever is greater--is to be devoted to agricultural research. The increase in the number of fairs coupled with increases in the monetary value of premiums has sharply reduced the amount available for agricultural research. In 1969 it was $298,964 (Table II-1). This figure was not only down from the 1968 figure of $506,731, but it was also below the minimum amount initially stipulated in the apportionment formula. Moreover, the department's research commitments for 1969, based on previous years' revenue forecasts, amounted to $322,567. Given this financial picture, which department personnel felt was likely to continue, Agriculture has sugggested that it receive a share of the Harness Racing Fund for research purposes before the initial split of these monies is made between the General Fund and the Pennsylvania Fair Fund. Such a change would provide the department with about $500,000 per year.

TABLE II-1

DEPARTMENT OF AGRICULTURE

DISTRIBUTION OF RESEARCH FUNDS, PENNSYLVANIA FAIR FUND
1966-1969

	1966	1967	1968	1969
Total Funds	$541,439	$596,226	$506,731	$298,964
Total Number of Projects	37	37	32	18
Performer				
The Pennsylvania State University				
Total Funds	$311,969	$395,090	$351,514	$204,427
Total Number of Projects	16	20	19	11
University of Pennsylvania (School of Veterinary Medicine)				
Total Funds	$136,844	$181,739	$135,820	$ 75,140
Total Number of Projects	15	14	10	4
Delaware Valley College				
Total Funds	$ 9,000	$ 9,000	$ 9,000	$ 9,000
Total Number of Projects	1	1	1	1
Pennsylvania Department of Agriculture				
Total Funds	$ 63,626	$ 10,397	$ 10,397	$ 10,397
Total Number of Projects	5	2	2	2

The department conducts limited in-house research. Its main function is to enforce regulations relating to animal, plant, and food production and marketing. Most of its research is performed on a contractual basis and administered by the Office of Planning, Evaluation, and Research. This office also undertakes market projects and manpower surveys.

Some research support comes to the department from federal programs, although most federal-state cooperative programs are for marketing reports and inspection services. Federal agricultural research is funneled mainly through the land-grant universities.

Research decisions are made by the department's research committee. Established by legislation, it is comprised of the secretary of agriculture, the dean of the College of Agriculture at The Pennsylvania State University, and the dean of veterinary medicine at the University of Pennsylvania. In addition, the secretary of agriculture has included on the committee or has sought the advice of the chairmen of the House and Senate Agriculture committees, the master of the state Grange, the head of the Pennsylvania Farmer's Association, and the president of the Pennsylvania Association of County Fairs.

Most proposals reaching the committee are unsolicited and originate with the state's universities and agricultural organizations. between 1966 and 1969, just short of 90 percent of all contracts w awarded to The Pennsylvania State University and the University of Pennsylvania. Though unsolicited in a formal sense, many of the proposals originating at the universities were apparently designed after consultation with state farm associations. Projects initiated within

the department, including those proposed by the Office of Planning, Evaluation, and Research, are also reviewed by the Research Committee.

There is a view within the department that changes are required in its overall research strategy; e.g., more research should be devoted to marketing and development studies. The existing research orientation and the associated choice of projects not only turn attention away from many short-run department problems but also prevent the necessary long-term research from being undertaken.

Projects supported with Fair Fund proceeds have covered a wide variety of commodities and agricultural activities. They have included studies of animal diseases, irrigation facilities, economic potential of the turfgrass industry, and various topics related to aspects of dairy and beef cattle, poultry, wheat, forest trees, forages, grapes, horses, soil testing, nursery products, apples, swine, mink, potatoes, and flowers.

The dissemination of research results is left primarily to the individual performer. This is handled by technical reports, papers at professional meetings, and press releases. The department plays little direct role in dissemination, but it has compiled and distributed a report on the progress of projects conducted in 1969.

Within the department, it is felt that greater attention should be paid to developing a significant in-house capability. This approach would provide stronger guidelines for developing departmental programs, especially as they relate to farm policies and plans for rural development.

Department of Commerce

Research activities within the Department of Commerce, conducted by the Bureau of Industrial Development, are entirely financed through General Fund appropriations. The Bureau of State and Federal Economic Aid administers research funds through Section 302 of the federal Appalachia Act; administration of this section was, until 1970, supported on a matching basis (75 percent federal-25 percent state). Research in the Bureau of Travel Development is financed mostly with Section 302 funds plus in-house support and administration funds from General Fund appropriations.

The Bureau of Industrial Development contains two major divisions: Research and Plant Location. The former operates in four general areas: (1) assembly and analysis of data on natural and marketing resources in the state; (2) assembly and analysis of data on current economic conditions; (3) preparation of special reports for the Governor's Economic Advisory Council (G-EAC); and (4) assistance in site-location surveys of the Plant Location Division.

Studies and reports in the first two areas are formulated by the bureau and division staffs and may be conducted at the request of the department secretary. Contracted research has included:

1. Survey of Forest-Based Industries (1965)--cost, $10,000.
2. Market Regions and Component Sources Study (1968-69)--cost, $12,000.

Recent in-house research projects have included studies of property tax rates and assembly of forest industries data. In addition, the division updates previously published documents on industrial and economic resources and conditions in the state. On the average, one new general study--typically lasting a year or less--has been produced by the Research Division every two years, and these studies are periodically updated. The information obtained is released to government agencies, the general public, and to industrial prospects through the Plant Location Division.

Studies done for G-EAC may be conducted at the request of either that body or the governor's office. Completed projects include studies of defense spending in the state, minority employment, revenue forecasting, industrial location shifts, and industrial expansion. These help to provide a basis for evaluation of the industrial development assistance and loans program and also serve to advise G-EAC of the current status of the state's economy. Reports submitted to G-EAC have related to in-house research, although the Federal Reserve Bank of Philadelphia assisted with the study of industrial location shifts. All projects have had a short duration but will be periodically updated with current data.

While it is not possible to determine an exact allocation, perhaps 25 percent of the work performed by the Research Division ($10-12,000 per year) can be classified as research. Other activities include revision of published documents and provision of services to other divisions and bureaus in the department.

The activities in the Plant Location Division do not involve formal research of the type described above (i.e., resulting in a public document). This division conducts confidential studies and provides general services to firms. Each confidential survey may involve one or more of four steps: (1) providing general information on site availability and economic conditions in the state; (2) providing information on specific industrial sites; (3) on-site determination of the availability and condition of specific industrial sites; and (4) assisting in-person inspection by company representatives of specific sites. The process involved in steps 1-3 generally involves a week to two weeks; in a year the division might conduct 400 such surveys. All services are provided free of charge to the companies requesting them. The Plant Location Division obtains information and data from a number of other state departments, including Labor and Industry, Education, Revenue, Health, and Highways.

The Bureau of State and Federal Economic Aid administers a variety of programs aimed at correcting physical and environmental deficiencies which inhibit the Commonwealth's economic growth. Research programs are administered through Section 302 of the federal Appalachia Act. While the Department of Commerce does not have line responsibility for executing the Appalachian developmental activities, the secretary of commerce, as the governor's representative to the Appalachian Regional Commission (ARC), must review, coordinate, and sponsor all programs proposed by other departments and agencies.

The Appalachia Division of the bureau, assisted by the State Planning Board and seven regional development district councils,

prepares an investment plan for economic development in the Appalachian region of the state. The research program has been oriented toward improving the infrastructure necessary for economic development: transportation, pollution control, community services, health, and education facilities.

The research program of the bureau is unique since it is one of the very few state agencies which formally fund unsolicited research proposals. To date, Section 302 funds have assisted in the following projects:

	Project	Completion Date	Section 302 Funds
1.	Appalachian Thruway Study	8/15/69	$ 7,800
2.	Air Pollution Study (Laser Beam)	2/15/70	75,000
3.	Travel Investment Study (Northeast Pennsylvania)	12/15/68	6,120
4.	Travel Investment Study (Pennsylvania--general)	10/15/69	60,000
5.	Fayette County Amphitheater Study	3/5/70	5,130
6.	Rural Health Planning Project	in progress	45,555
7.	Vocational and Technical Education Study (Operation Leader)	in progress	35,000
8.	United Black Front Manpower Training Study	in progress	60,280
9.	Northeast New Communities Study	in progress	75,000
10.	Southeast Site Development Study	in progress	15,000
11.	Geisinger Anemia Study (Supportive Services)	in progress	36,550

The last four studies were initiated in fiscal 1970 and are not included in the expenditure account in Appendix A.

The Travel Development Bureau participated with $30,000 of in-kind services toward project 4; the Department of Community Affairs is contributing $25,000 to provide direct manpower training in connection with 8. The State Planning Board is providing $5,300 as in-kind services toward project 9.

In addition to the projects being aided with Section 302 funds, two research projects will be supported with Section 202 funds. Fifty thousand dollars from the Appalachian Regional Commission is being made available under this section for a health area demonstration project in the Susquehanna Economic Development Association (SEDA) district. This is in addition to the SEDA rural health planning study. Also, ARC is providing $50,000 for a child development demonstration project. Currently being developed is a $250,000 multi-school district operational in-service teacher training proposal for the northwest and north central districts.

Upon receipt of a research proposal, the bureau turns it over to the state agency or agencies most directly concerned with the research topic (e.g., health, education). These in turn make the initial evaluation. The Appalachia Division of the bureau then evaluates the proposal in light of the objectives of this program. Finally, the proposal is submitted for approval by the governor's office. The Appalachian Development Plan, part of the state plan, sets the priorities followed for funding.

Contracts for research projects are written by the general counsel of ARC. A contract may be written directly with the research performer using the state's appropriations from ARC, or it may be between ARC and the state, with the research performer receiving a subcontract. Because no state appropriations are involved in the research program, open bids are not required. The research contracts are monitored by both federal and state personnel through written drafts and on-site visits. Implementation of the findings of each research project is the responsibility of the local districts or the state agencies. The Appalachia Division can assist in implementation through its investment development programs.

The Bureau of Travel Development has funded several contract research projects using Section 302 funds and General Fund appropriations. These projects are:

1. Travel Investment Study--Northeast Pennsylvania (1968)--cost, $6,120 (302 funds).

2. Travel Investment Study--Pennsylvania, general (1968-69)--cost, $60,000 (302 funds) plus $30,000 for in-house services (General Fund).

3. Travel Investment Study--Centre County, Pennsylvania (1969)--cost, $9,600 (General Fund).

4. Economic Impact of Tourism--Pennsylvania, general (1965-66)--cost, $10,000 (General Fund).

The major work has been oriented toward informing the potential investor of opportunities for recreation and tourist development in the state, especially near existing state parks. This orientation recognizes that companies may locate plants in areas with adequate recreation facilities. The idea for the travel investment studies resulted from

the failure of the Department of Forests and Waters to receive any bids on a prime parcel of state-owned land at an I-80 interchange. Subsequent meetings between representatives of Forests and Waters and Commerce resulted in the research contract. The research contract was on a single source basis since the contracted consulting firm is a specialist in the areas of both industrial and recreational development. Moreover, the research project itself was considered a pioneering venture in evaluation of investment opportunities.

Monitoring of the project was accomplished by personal meetings and written drafts. The in-house staff was heavily involved in the progress of the study. The general study of travel investment opportunities in Pennsylvania resulted in thirteen published documents; single documents are available from the other projects.

Research programs in the Department of Commerce cover a broader range of subjects than the department's name might suggest. Research has been directed at developing the infrastructure necessary for industrial development, in particular, and economic development, in general. The department has studied specific problem areas associated with transportation, health, education, air and water pollution, recreation, and community facilities. Some of these are areas of traditional governmental concern (e.g., health) while others represent concern with the extra (social) costs of economic development (e.g., pollution).

Pennsylvania Science and Engineering Foundation

The Pennsylvania Science and Engineering Foundation (P-SEF) was created by a legislative act in 1967 and began operating in January 1968. The foundation was created to "promote, stimulate and encourage (1) basic and applied research and development in Pennsylvania and (2) scientific and technological education in Pennsylvania, which may reasonably be expected to advance the Commonwealth's economic growth" (Section 2503-13, Act of April 19, 1929, P.L. 177, as amended).

By statute, the foundation is located within the Department of Commerce. P-SEF policy is determined by its board, which, by statute, consists of the secretary of commerce, the governor's science advisors, and nine additional members, who are appointed by the governor with the advice and consent of the senate (four of the additional nine must be drawn from the Governor's Science Advisory Committee). Board members serve for a four-year term concurrent with that of the governor; to date they have been drawn from industry and from universities, both public and private. The board's actions are administered by an executive director, who is a staff member of the Department of Commerce.

P-SEF funds are received as line-item appropriations in the General Fund budget. The initial funding for fiscal 1967-68 amounted to $1.4 million, the sum which was also appropriated in each of the next two fiscal years. The governor's budget request for P-SEF for fiscal

1970-71 dropped to $800,000. No final legislative determination of P-SEF's budget had been made at the time this report was

Within its general mandate to support those research and educational activities that could enhance the state's economic growth, the board has had considerable flexibility in determining which projects were deserving of support. Its charter permits it to enter into contracts and agreements with educational institutions, nonprofit institutions and organizations, business enterprises, persons concerned with scientific and technological research, as well as with any state or federal agency.

Nominally, all of the proposals funded by P-SEF are unsolicited, in the sense that they emanate from researchers outside the board or the state government. In practice, however, P-SEF has taken an active role in helping develop and coordinate interest within the universities in areas of its choosing. This role reflects another aspect of P-SEF's policy, i.e., to support the creation of formal centers for research, rather than to rely solely on proposals from individuals. In this regard, P-SEF has been instrumental in the creation or support of the Institute for the Development of Riverine and Estuary Systems (IDRES), the National Transportation Center, the Great Lakes Research Institute, the Regional Development Laboratory, and the Center for the Study of Science Policy.

In reviewing proposals, P-SEF has established the following criteria: timeliness and potential for spurring economic growth; probable avenues for subsequent funding by federal, industrial, or other sources; technical quality and administrative feasibility; special

competence of the institution making the proposal; and special need for the P-SEF seed funds.

In addition, the following guidelines have been employed: activities should be implemented, in the main, within the state; some contributory matching effort should be provided; and P-SEF support should be phased out in multi-year projects.

The P-SEF board, in consort with G-SAC, has identified the following areas as those in which it would place greatest support: (1) pollution and allied environmental problems; (2) materials science and building technology; (3) medical, biological, and allied fields; (4) marine science and engineering; (5) urban problems; (6) public health; (7) transportation; (8) nuclear energy; and (9) communications. Between fiscal 1967 and fiscal 1970, P-SEF awarded $4.2 million to 80 projects. Total expenditures on these projects came to $21.2 million, of which P-SEF contributed 20 percent. Federal augmentations of P-SEF awards amounted to $10.1 million (or 47 percent of the total), industrial augmentations to $3.5 million (17 percent), and university augmentation to $3.5 million (16 percent). (These totals are overstated somewhat by double counting procedures built into university submission of contracts to both federal sponsors and P-SEF.)

Approximately 80 percent of P-SEF's funds have been awarded in its chosen areas of emphasis, as follows: materials--16 percent; pollution control and environmental protection--13 percent; biomedical engineering, and health care delivery--16 percent; transportation--13 percent; and marine engineering--12 percent. "Grubstaking" grants which support projects of individual faculty research have amounted to

about $449,000. Another $372,000 has been spent on a variety of projects designed to provide internships and fellowships. Finally, a two-year, $139,000 grant was made to the Southeastern Pennsylvania Economic Development Corporation to provide entrepreneurial aid to investors and business in developing new enterprises.

A total of eighty projects have been supported at thirty institutions. Most have gone to universities and colleges within the Commonwealth; a smaller number have gone to nonprofit institutions in the state and to support cooperative programs between universities and private industry. This focus on university-based research has been the subject of constant discussion within P-SEF. The board's charter permits it to enter into contracts with private firms. Moreover, under a policy adopted at its first meeting in February 1968, the board determined that it would give the awardee patent rights to inventions developed under P-SEF projects, with the reservation "to the Board on behalf of the Commonwealth [of] a nonexclusive, irrevocable and royalty-free license for the manufacture by or for the use of the Commonwealth, its agencies or instrumentalities."

Department of Community Affairs

The Department of Community Affairs provides a system of programs directed toward the development and redevelopment of Pennsylvania's communities to enhance the total environment. A primary objective is to improve the capabilities of local governments to meet critical social and economic problems.

Research activities in the department are contained in several operating divisions and in a Bureau of Research and Program Development. Projects within this bureau deal mainly with local government operations and, for the most part, studies are done to aid the department's total operations. However, some studies are clearly aimed at specific problem areas in the state if they can as well serve as prototypes for general application. For example, the bureau has contracted for a comprehensive research study of housing in Pennsylvania and has also supported the development of low-cost housing in the Johnstown area.

To date, funds for the Bureau of Research have been provided only through state appropriations. For the past two years it received more than $200,000 annually for contract research and program development, but for fiscal year 1969-70 this amount decreased to $50,000 due to the general cutback in departmental appropriations. With respect to the budget process, it is the bureau's duty to screen the research needs

of the department and submit estimates as line items within the department's budget.

Urban redevelopment, housing, and local government problems have consumed far more contract research than any other areas. Since 1966, almost $150,000 has been spent on urban redevelopment and housing projects and more than $275,000 to investigate problems involving local government structures and functions, finance, and administration. However, while these are the most important areas of research within the department, state and federal funds are used for research in other divisions.

State appropriations support research in three areas: first, the Mass Transportation Division used General Fund appropriations for contract studies of urban and high-speed transportation. Second, Project 500 funds are supporting a research project in the Recreation and Conservation Division, and third, a special legislative appropriation of $174,873 is being used to study the feasibility of utilizing railroad property and air rights for housing construction, recreation, and other community improvements. This study is being performed by the Philadelphia 1976 Bicentennial Corporation under the auspices of the Bureau of Community Programs.

Federal funds, with matching state appropriations, have also been used in three instances. Prior to 1966, federal funds from Section 701 of the Housing Act of 1954, as amended, supported an urbanization impact contract study in the Bureau of Community Planning. The Bureau of Local Government Services currently has a contract study of public employee labor relations under Title IX of the Demonstration Cities

and Metropolitan Development Act of 1966. Finally, the Bureau of Human Resources received a demonstration grant from the Office of Economic Opportunity for fiscal 1970.

Local Government Research

The Bureau of Research and Program Development has some flexibility in selecting its projects. The priority rank of research projects is established by the Program Evaluation and Review Committee (PERC),* which is guided by legislative intent, the views of the department secretary, and the governor's office as to the selection of projects to be funded with state money. Most studies done by this bureau are one-year contract research projects. The majority of research ideas come from within the department (executive staff--secretary, deputies). Occasionally ideas come from the governor's office, and in a few instances, research has been done at the request of legislative committees. Local government associations also request certain studies. In-house research is generally of shorter duration, averaging 2-3 months, with a maximum duration of 18 months.

Very few, if any, unsolicited proposals for research have been funded by the bureau although there are no formal administrative or legislative prohibitions against funding such proposals. Contracted research has included studies in the fields of urban renewal and housing,

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*The PERC membership includes the secretary, executive deputy secretary, deputy secretary, executive assistant to the secretary, urban affairs advisor, director of the Bureau of Management Services, and, when appropriate, the director of the bureau whose program problem is being discussed.

local government, financing, structure and techniques, educational programs, and constitutional implementing legislation.

When research is contracted, Office of Administration requirements are followed in selecting the contractor or consulting firm. Although there are no formal guidelines for determining who may be hired as a contractor, an informal rule suggests that preference generally be given to consulting agencies working within the state. Once bids have been received, an ad hoc review committee is set up, composed of members of the department and representatives from the Office of Administration. It ranks the proposals received and forwards them to PERC for final review. The Office of Administration may bring in outside experts to review very technical proposals.

Once the contract has been let, various control procedures may exist. For certain contractors occasional progress reports are received by the Research Bureau as a condition of the study. In all cases a draft of the final report is reviewed by the bureau before the completed report is obtained from the contractor. The final report is sent to the Bureau of the Office of Administration for review. Typically these reports are distributed within the state government and to parties outside who might have interests in the same area. Research done within the bureau is distributed to other state bureaus, local government associations, and local government officials through a bulletin published by the Bureau of Research.

Mass Transportation Research

In the operating divisions of the Department, almost all research projects have been contracted out since in-house capabilities and staff were not available. In the Mass Transportation Division, three research studies have been completed using General Fund appropriations.

Mass Transportation Research

Project	Contractor	Completion Date	Cost
(1) Mass Transportation Economic Study	Pennsylvania Economy League	1967	$3,648
(2) High Speed Transportation Study	Westinghouse Air Brake Company	1967	$80,000
(3) Keystone Corridor Study	L. Klauder and Associates	1967	$17,091

Projects 1 and 3 are considered part of the enabling legislation which created this division in 1966; project 2 was commissioned by the Pennsylvania Department of Commerce at the suggestion of the Governor's Science Advisory Committee (G-SAC).

The selection of contractors for the above projects was carried out in the division with the aid of the Departments of Commerce and Highways. About ten proposals were reviewed for both projects 2 and 3. All three contractors were based in Pennsylvania.

Each project had a duration of under a year, and verbal reports and rough drafts were used to monitor them while they were in progress. Project 1 is to be kept up-to-date for in-house planning use while the second project is being implemented by the Department of Commerce through

the purchase of rolling stock. Governor Shafer directed project 3 to the legislature for implementation.

Currently, the Mass Transportation Division does not contemplate further research studies but will concentrate on demonstration projects. The division does, however, collect information on research projects at the federal level. The department's Bureau of Research has not participated in the formation or monitoring of transportation research. Effective July 1, 1970, the Mass Transportation Division was assigned to the Pennsylvania Department of Transportation (PENNDOT).

Recreation and Conservation Research

The Recreation and Conservation Division is currently involved with one research project--part of a study of local government park and recreation development in Pennsylvania--which is being carried out under the auspices of the State Planning Board. Setting up the project and selecting the consultants took about six months.* The interviewing of the consultants and evaluation of their proposals was carried out by a committee consisting of the division chief and his staff and State Planning Board personnel. The State Planning Board also reviewed the entire scope of the study.

Two types of consultants are involved--specialists in parks and recreation and specialists in local government affairs. As the scope of the project developed during the interview phase, the differing

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*The Bureau of Research participated in the project at this stage by assigning one research analyst to the Recreation Division for six months.

abilities of these two groups were incorporated in the study methodology.

Total cost of the project is $130,000 (Project 500 funds), broken down as follows:

The Pennsylvania State University, Recreation and Parks Program	$33,750
Better Government Associates	20,000
George Kemp and Associates	18,500
Programming of Inventory Data	11,325
Publication Costs (State Planning Board)	20,000
In-House Costs	26,425
Total	$130,000

The contracts began in June 1969, and all research was expected to be completed within a year and a half. During the first nine months of the study, the Recreation Division staff met about ten times with the three contractors to monitor progress of the study.

Human Resources Research

In the Bureau of Human Resources a one-year (1970-71) research and demonstration project has been funded with $11,000 by the U. S. Office of Economic Opportunity. If the project shows significant promise, an additional year's extension will be sought. This project will study and evaluate the effectiveness of four rural planning specialists, two of whom will be delegated to Community Services of Pennsylvania, and two of whom will be sent to county planning commissions. The evaluation will be conducted by the College of Agriculture at The Pennsylvania

State University. In addition to the Bureau of Human Resources, the Bureau of Community Planning and Community Services of Pennsylvania were involved in the implementation.

The Bureau of Human Resources has a staff research analyst who evaluates the various projects in the Manpower Employment Assistance Training Program, and has contracted with Penn State for a follow-up study on all of the graduates of the first-year programs.

In summary, the Department of Community Affairs is a relatively new state agency concerned with many of society's critical domestic problems: housing, transportation, poverty, urban renewal, land and water conservation, and reclamation, and with local government response to these problems. To date, the department's research activities have been somewhat more narrow in scope than the total responsibilities of the department. One might expect that growing public concern for solutions in these problem areas, and possible changes in federal funding priorities, would result in broader based research support for Community Affairs.

Department of Education

Research activities within the Department of Education are concentrated in the Bureaus of Research and Statistics, but several other department bureaus also have research-oriented programs. In the Basic Education program, the following bureaus conduct research activities:

1. Bureau of Curriculum Development and School Evaluation
2. Bureau of Educational Quality Assessment
3. Bureau of Administrative Leadership Services
4. Bureau of General and Academic Education

Within the Higher Education program, the Bureau of Planning (formerly Institutional Studies and Services) has some research responsibilities. Although almost all bureaus in the Department of Education are continually involved in programs which contain informal research elements, this report concentrates on the department's more formal research activities.

The primary responsibility of the Bureau of Research is to study educational programs and needs of the state; educational practices and administration are examined and consultative services are provided to local school districts. The bureau has been concerned mainly with the activities of the Basic Education program, but in the future more work will be performed for Higher Education.

Funds for research projects come from state and federal appropriations. Some solicited private foundation funds (e.g., Ford Foundation) have also been received. Federal funds for vocational research are obtained through a research coordinating unit (RCU), which in turn uses the funds received for contract research with other educational agencies. Some research is conducted by the RCU staff. Estimated research expenditures in the Bureau of Research are presented in Table II-2. These figures do not include certain projects, such as preparation of bibliographies and administrative research.

Proposed research projects in this bureau are screened by a research priorities committee whose voting members are the deputy secretary of education, the director of the Office of Research and Statistics, and the commissioners for Basic Education and Higher Education. The bureau directors of Research and Statistics are advisory, nonvoting members. All research projects are not evaluated by the committee, as each bureau director makes his own decisions on "minor" projects. However, on major studies the committee considers the projects in light of departmental research priorities.

Bureau of Research projects are initiated mainly by the operating divisions through oral or written communications, but sometimes the bureau initiates a proposal. Proposals are screened by the research staff. In the past, major proposals were also directed through the deputy secretary's office for his approval.

The Bureau of Research periodically publishes a list of completed projects. Research projects completed in the last five years have concerned curriculum development (driver education, programmed

TABLE II-2

DEPARTMENT OF EDUCATION

BUREAU OF RESEARCH

RESEARCH EXPENDITURES

Fiscal Year	Total Expenditures			In-House				Contract			
	State	Federal	Ford	State	Federal	Ford	Total	State	Federal	Ford	Total
1969-70	$ 31,716	$ 91,504	$ 13,913	$ 19,236	$ 80,447	$ 4,758	$104,441	$ 12,480	$11,057	$ 9,155	$ 32,692
1968-69	258,264	113,605	24,653	170,416	98,493	24,653	293,562	87,848	15,112	--	102,960
1967-68	175,744	161,742	16,285	78,247	103,655	16,285	198,187	94,497	61,087	--	155,854
1966-67	152,520	182,058	109,411	51,605	129,978	2,875	184,458	100,915	52,080	106,536	259,531

instruction); quality of education (test norming); management and administration (extended school year); teaching (pupil evaluation); vocational education (manpower training needs); and higher education (comparative analysis of state expenditures). External funding support for various projects is listed in Table II-3.

TABLE II-3

EXTERNAL FUNDING, BUREAU OF RESEARCH

Project	Duration	Amount	Support Agency
1. Culturally Disadvantaged	1964-69	$400,000	Ford
2. Driver Education	1964-67	36,000	USOE
3. Language Laboratory	1965-69	230,000	USOE
4. Programmed Instruction	1962-65	187,800	USOE
5. Reading Studies	1964-68	90,000	USOE
6. Teacher Feedback	1965-67	111,000	USOE

Whenever possible Bureau of Research projects are conducted in-house. Contracted research in fiscal year 1969-70 totalled only $32,692. Bureau personnel cited the following as advantages of in-house research:

1. Better control of the research design.
2. With contract research, final reports may not answer all questions and consultants will have "moved on."
3. In-house staff can better assist in implementation if they have also conducted the research.

4. Contract research consultants need time to learn the jargon and complexities of various programs.

However, consultants may also bring an unbiased view to a research project and, in some cases, there is a need to involve other disciplines. In one case where an outside consultant was used, he was given office space in the bureau so that he could work closely with the staff.

Because of the construction of the school year, many Bureau of Research projects have lasted more than a year. Each project is closely monitored during its progress. Contract research is monitored by written draft, oral communication, and on-site visits; in-house projects require monthly reports plus visits to projects in the field. This system allows the bureau to modify or redesign projects while they are in progress.

Well-established dissemination procedures are followed at the completion of each project. These include:

1. Final reports of completed research and PREP (Putting Research into Practice) reports sent to each chief school administrator and education development center.
2. A research coordinating unit newsletter and bureau list of completed research projects.
3. The Quarterly Bulletin for Vocational Education and Pennsylvania Education Bulletin.
4. The national ERIC (Educational Resources Information Center) system.

In addition, a major part of the department's research program has been aimed at disseminating information on education practices through annotated bibliographies and information retrieval systems.

In the estimation of the director of the Bureau of Research, Pennsylvania has one of the country's largest ongoing state department of education research programs. The research staff grew from 10 professionals in 1956 to 30 in 1970. Most states have only one or two research people in education. (New York is an exception, but there most of the research is contracted out.)

Information on the research activities of other bureaus in the Department of Education concentrates on the contracted portions of various programs since the in-house research contribution is difficult to identify. In the Bureau of Curriculum Development and School Evaluation, no state funds are used for research as such. The Curriculum Development Division does produce, on the average, 10-12 "planning documents" per year which are released to the general public. These studies try to anticipate future problems and direct attention to the potential problem areas.

This bureau also administers and evaluates Title I and Title III appropriations under the Elementary and Secondary Education Act of 1965. Individual project proposals are written by local school district personnel. The bureau provides assistance in development of the project proposals; evaluation is accomplished by a monthly budget-reporting procedure and a yearly on-site visit. Evaluation criteria are either self-determined or administered by law.

In order to facilitate the development of project proposals at the local level, the bureau has undertaken several research-oriented projects to develop local abilities in several required areas. These projects include:

1. Program Evaluation and Review Technique (PERT) Workshops--approximately 30 workshops were conducted on the use of the PERT method. Cost of development by the consultant was $17,527 (1968-69).

2. Behavioral Objective Workshops--approximately 50 workshops were conducted on the use of behavioral terminology. Cost of development by the consultant was $4,700 (1968-69).

3. Evaluation Workshops--approximately 500 people were trained in evaluation techniques. Cost of development by the consultant was about $50,000 (1968-69).

Beginning in 1971, each Title I and Title III project proposal will contain a PERT chart and will be written in behavioral terms. Each proposal will also be connected to one of the state's sixteen education development centers. Currently, there is no contract research being conducted, and there were no research contracts prior to 1968-69. However, in light of the continual decline in Title III appropriations at the federal level, the state agencies view subcontracting as a desirable means of avoiding overstaffing within the department.

Title III appropriations also support the research of the Bureau of Educational Quality Assessment. This bureau was formed in 1966 to develop the department's capability to measure the impact of school consolidation on the quality of education (broadly defined in terms of ten sociological and educational goals).

The assessment program is being carried out in three phases. Phase I, a test of the assessment methodology, employed a sample of 2,500 fifth and eleventh graders. The cost of this phase, which ran from 1967 to 1968, was about $75,000; it was conducted in-house with Title III appropriations.

Phase II, an expanded and refined test of 37,000 pupils, was carried out during 1968-69 and included two subcontracts. One was

based on solicited bids for the study of subconscious attitudes toward education. This project, of one year's duration, was conducted by the Institute for the Study of Inquiring Systems in Philadelphia at a cost of $106,000. The second subcontract was a questionnaire survey supporting the sample tests. This project also lasted for one year and was conducted by Franklin Institute, Philadelphia, at a cost of $67,000. The in-house contribution during 1968-69 was approximately $78,350. Both the in-house and contracted portions of Phase II were financed entirely by Title III appropriations.

The in-house research budget for this bureau during 1969-70 was about $175,000 (Title III). Phase III, a recycling of Phase II, began last year. The Bureau of Research has also aided in the quality education program through the development of measuring instruments and test norming.

The Bureau of Administrative Leadership and the Bureau of General and Academic Education annually produce a number of planning documents which contain informal research elements to support their various programs. No in-house estimates for expenditures are available for the Bureau of Administrative Leadership. The Bureau of General and Academic Education receives federal appropriations under Title V of the Elementary and Secondary Education Act of 1965. These funds are employed to conduct research and evaluation and initiate pilot projects on instructional methods, materials, media, and programs.

Higher Education's Division of Institutional Studies and Analysis, Bureau of Institutional Studies and Services, was activated to provide research-oriented information to solve specific problems

related to higher education. A reorganization occurring on July 1, 1970, changed the name of the Bureau of Institutional Studies and Services to the Bureau of Planning. Coupled with the change in name is a change in function. The focus of research activities of the Bureau of Institutional Studies and Services had been on the identification, design, and implementation of research studies needed to supply information related to specific problem areas of higher education. Under the new Bureau of Planning the focus is similar in that ideas will continue to be generated and problem areas identified, but different in that greater emphasis will be placed on the development of cooperative channels for study implementation and solution.

One of the projects that had been started by the Bureau of Institutional Studies and Services and which is currently being completed by the Bureau of Planning is a questionnaire survey of the allied medical-health occupational field. The purpose of the study is to help the Commonwealth and its institutions of higher education plan their priorities and allot their resources in this area. Participating in the project are many of the state's colleges and universities, and the professional schools associated with health, the Bureau of Statistics, the Pennsylvania Hospital Association, and several manpower agencies. Progress reports have been and will continue to be sent to a broad spectrum of individuals and agencies associated with health care to encourage the cooperative interchange of information and to prevent duplication of effort.

The allied medical-health study was scheduled for completion in late 1970. Several other in-house projects are presently being

developed by the Bureau of Planning in keeping with its new function. In-house expenditures on the medical-health study were estimated at $67,123 in 1969-70 and $55,451 in 1968-69.

In summary, the research activities of the Department of Education contain elements which are common to the research activities of many other state agencies. Research projects are concentrated in a bureau of research, but formal and informal research and development are also found in operating divisions. Research priorities are now being established on an intradepartmental committee basis. Both in-house and contracted research are conducted.

On the other hand, there are several unique features associated with the research in this department. The scope of the research activities is extremely broad and projects are of longer duration than is common in most state agencies. The Department of Education is one of the few agencies whose research and development activities have been supported by private foundation funds. Finally, the possibilities for dissemination of research findings are generally greater in this department than in other state agencies.

Department of Forests and Waters

Research support for the Department of Forests and Waters is derived from state appropriations. These funds are contained within the operating budgets of the department's main bureaus and not as a separate line item. Because the department's research activities have been limited it has not been felt necessary to develop a central research unit or to develop final procedures for project determination, selection, and administration.

This decision is based upon (1) the department's functions, which involve timber management in the state forests, cooperative forest management on private lands, production of quality tree seedling stocks, statewide surveillance and control of insect and disease problems, protection from fire for all forest lands in the state, provision of recreational and cultural enrichment opportunities for Pennsylvania's citizens and visitors, flood control activities on the waters of Pennsylvania, and water resources management; and (2) the research facilities of the U. S. Forest Service and other federal agencies, which provide much of the research that is required in the department's operations.

Research projects are undertaken on an "as needed" basis within each bureau. The general policy is for research projects, which originate with the bureaus, to be performed on a contract basis. There is little funding of unsolicited proposals. The department's

view is that higher quality research can be performed if the research is contracted out rather than if it is performed on an in-house basis. In part, this view seems to be based upon the department's close ties with the research facilities at The Pennsylvania State University. The limited availability of in-house manpower also accounts for the reliance on contracted studies.

Research projects financed by the department tend to focus on reforestation efforts and demand projects for planning purposes. The Bureau of Forests since 1967 has provided $25,000 annually to The Pennsylvania State University for the evaluation of sample forest plots. In 1969 the bureau contributed $10,000 to Penn State as its share of a cooperative watershed study, and $4,500 to the Northeast Forest Experiment Station of the U. S. Forest Service for a study of the revegetation of strip-mine spoil banks.

The Bureau of State Parks employed Battelle Memorial Institute of Columbus, Ohio, to determine user characteristics of state park visitors as a basis for long-term planning. It has also been engaged over the past three years in developmental, collection, and evaluation work on aquatic weed control. This project in many ways is representative of much of the research activity occurring within the department. A specific problem was encountered--weeds were befouling the state's lakes--and the bureau employed its own staff to seek a solution. Since the problem was also of concern to other state agencies, particularly the Department of Health and the Fish Commission, an informal arrangement was reached on a cooperative venture, with main responsibility remaining within the Bureau of State Parks. Much of the project

has entailed data collection and tests of the effectiveness of commercially available products, but other aspects--e.g., attempts to control for different variables, modification of products--resemble applied research and development work. Also, as with many projects in other state agencies, the expenses for this study are treated as part of a general program, in this case, aquatic weed control, so that no direct figure for research expenditures is available.

The department has allocated $7,350 to the U. S. Geological Survey to conduct a two-year study to document the ecological succession of an impoundment following the application of herbicides to control nuisance growths of algae and/or aquatic plants. Aquatic plant succession has not been recorded for Pennsylvania waters. Documentation is believed important since it is possible that in eradicating one particular nuisance growth another nuisance may develop that is more of a problem than the one originally treated.

Planning studies are far more important in the department's activities than technical research projects. Each bureau within the department is engaged in a number of planning studies with bureaus of various federal agencies. The impetus for these studies often comes from the federal government. With several of these studies, the department's costs amount to a prorated share of administrative expenses; with others the department pays a major share, which exceeds the total amount spent on more narrowly defined research. The department, for example, has allocated $190,000 as its share of the state's comprehensive outdoor recreation plan. Of this amount $95,000 will be reimbursed by the Bureau of Outdoor Recreation, U. S. Department

of Interior. The department's study of "Outdoor Recreation Horizons" will be used as a guide for immediate and long-range program and development decisions.

The Bureau of Engineering finances some research projects to establish better hydraulic and hydrologic design criteria. To date, this research has been oriented toward obtaining design criteria which can be directly applied to the bureau's action program. Other research includes studies of aquatic vegetation at Pymatuning Lake and Conneaut Lake, conducted by the University of Pittsburgh, and studies concerning lake management as affected by sedimentation, eutrophication, etc. in a jointly financed program with the U. S. Geological Survey. Coordination of research is through the Pennsylvania Water Resources Coordinating Committee, as well as the newly formed Interagency Research Committee. The Bureau of Engineering is currently registering all of its research projects with the Science Information Exchange. This has been done in cooperation with the Office of Water Resources Research, which has requested the Science Information Exchange to catalog all water resources research.

Department of Health

The focal point of all research and development conducted in the Department of Health is in the Bureau of Planning, Evaluation, and Research.

This bureau includes three major operation divisions--Planning, Behavioral Science, and Research and Biostatistics. Research related to other functional units within the department (such as in the areas of environmental health and nursing programs) pass through the Bureau of Planning, Evaluation, and Research. Basic research in health funded under the Health Department budget also takes place at eight outlying institutes and hospitals. Administratively, this research is not controlled by the department, as funds for these centers are direct line-item budget appropriations. The eight centers are:

1. The Institute for Cancer Research, Philadelphia
2. Wistar Institute, Philadelphia
3. Lankenau Hospital, Philadelphia
4. Philadelphia General Hospital, Philadelphia
5. St. Francis Hospital, Pittsburgh
6. St. Christopher Hospital, Philadelphia
7. Children's Hospital, Pittsburgh
8. Hahnemann Medical College, Philadelphia

All research in the Department of Health is of an applied nature. The eight centers concentrate on basic research problems related to cancer, heart disease, cerebral palsy, and diseases of the chronically ill and aged.

Total expenditures on research and development have been relatively constant for the past few years. There is no established process by which the department determines the amount of funds going to research and development. Because no proposal for other than a negligible increase in research expenditures has been approved by the legislature in recent years, the department's increase in its research activities has been pieced together from general administrative funds. The bureau sees itself as having a missionary role of establishing the validity of the need for research to give direction to program operations and to improve their economy and efficiency. Federal funds to support research are provided by various federal programs. The amount of administrative control exercised by the state, however, makes it difficult, in the view of the bureau, to use these funds with maximum efficiency. Research expenditures for fiscal 1969 totalled $1,196,000, of which $874,000 came from the General Fund and $322,000 from federal programs, mainly for environmental health. In addition, $785,000 was appropriated directly by the state to six institutions.

Research projects are proposed to the Bureau of Planning, Evaluation, and Research by numerous sources. Because this bureau acts as the problem center within the department for all other bureaus and divisions, many of the suggested research projects derive from problems encountered by the department's field personnel. Another important source of research proposals is the research staff and their particular areas of interest. Bureau representatives feel that much of the department's best research occurs when it has the flexibility and funds to permit its staff to work on projects they have

proposed. Projects also develop in response to political and public interest, e.g., environmental quality. In some cases, the availability of earmarked research funds, usually from the federal government, allows for research in selected areas. Finally, in many cases ongoing projects lead to further problems in the same area and thus new projects.

There is no organized set of rules regarding the amount of research that must be done in any one area or group of areas. All projects, however, are screened by the department's research review committee. The primary jobs of this committee are to:

1. Examine each project to see if it is in line with the aims of the department.
2. Examine the research design to see if it is adequate.
3. Determine if the researcher is qualified to handle the project.

At present, work is being done in conjunction with the Pennsylvania Science and Engineering Foundation to establish a general committee and several regional committees to adapt statewide priorities to local needs for research.

The largest portion of the department's research is done in-house; few projects are performed on a strict contractual basis. The reason for this seems not to be any particular prejudice against contracted research, but because the limited funds allocated to research are exhausted by in-house work.

Because most of the research is done in-house, no formal control procedures are set up for the supervision of various research projects. All in-house studies involve direct participation by either the bureau director or one of the division directors; thus

control of these projects is really part of the daily operations. Their administration is subject to the same rules and regulations that control all program operations.

The dissemination of findings from the various research and development projects within the Department of Health to its operating divisions and the public takes place in two general ways. Findings are distributed internally, via the usual interoffice communications channels, to other divisions that are interested in and have the ability to make use of the findings. A number of the research findings of the department are of interest to other areas of public health. Such information is passed from the department directly to the interested parties or, in numerous cases, is published in scientific journals. Findings appropriate for lay audiences are published in periodic news releases.

Department of Highways

Financial support for highway research is provided to the department through a percentage of the funds granted the state under federal highway programs. The Interstate and ABC highway programs provide that 1-1/2 percent of the state's total allotment be designated for research and planning. The division of funds between research and planning apparently differs widely from state to state and even within a given state from year to year. This provision in the federal highway programs was designed to generate a research and planning capability within state governments. It is of recent origin, dating back to 1962 amendments in the Interstate Highway Act. The distribution, however, of the state's funds between research and planning is a management decision made within each state highway department. The Pennsylvania Department of Highways receives no state appropriation for research, although representatives believe it might be possible to employ some proceeds or earmarked highway taxes for certain types of research.

The department initially devoted the greater part of its "1-1/2 percent" money to planning, e.g., traffic counts, municipality studies, state maps. Recently, a greater emphasis has been placed on research support. For fiscal 1969, the department received $5 million for highway planning research, of which $3.7 million was spent for planning studies, mainly of an in-house nature, and $1.3 million

for contracted research. In 1968, $1.4 million was spent on research, $1.2 million of it on contracted projects (Table II-4). Pennsylvania ranked fifth among the states in fiscal 1969 in terms of its expenditures for highway research and development.

TABLE II-4

PENNSYLVANIA DEPARTMENT OF HIGHWAYS

RESEARCH BUDGETS

Year	Highway Planning and Research - Total	Contract	Pennsylvania Department of Highways
1964-65	$ 900,000	$ 767,000	$133,000
1965-66	1,078,200	991,200	87,000
1966-67	695,677	496,677	199,000
1967-68	650,000	496,418	154,582
1968-69	1,373,520	1,205,621	167,899
1969-70	1,691,300	1,345,900	345,400

The department's increased interest in research has also led to major changes in its research strategy and in research administration. Until about 1967, most research proposals were received on an unsolicited basis from outside researchers, usually from the state's universities. Many of the proposals were funded by the department from money provided under federal highway programs, but there was no consistent pattern to the type of research done and little systematic effort to ensure that projects were related to operational needs or that research results were transmitted to operational units.

The department's main research program is now formulated by members of its research and development advisory group, who serve as advisors and consultants to the Bureau of Materials Testing and Research (M & R). This group, which does not itself conduct research, is headed by the director of the Bureau of Materials Testing and Research, who is responsible for conduct of the program. Coordination of the program is handled by bureau personnel. M & R surveys the department's operating bureaus for their research needs. This policy is designed to ensure that the department's research projects are "problem oriented" rather than "basic," and that they are related to the problems of the state.

Materials Testing and Research, which receives proposals throughout the year, expends considerable effort in surveying the research activities conducted by other states and the federal government in order to avoid duplication of effort. The bureau has tended to favor research projects which offer quick returns to the department. This policy has reflected both the view that studies should be related to immediate needs and the feeling that when state highway funds are involved (as they may be, given the increased size of the department's research program), earmarked tax proceeds should be used for short-term specific projects.

Most of the department's research is related to materials, and the majority of its contracted research is performed by universities and private firms within the state. There is no formal prohibition against contracting with out-of-state performers, and there have been cases of such contracts. The department has employed two criteria in

selecting such performers: their pre-eminence in a certain area, and the research was to be of a short-term nature. If a long-term research project was proposed, the department preferred to deal with an in-state facility, even if it meant developing the existing capability. An example of the latter type was the department's joint venture with The Pennsylvania State University in undertaking long-term research into the properties of bituminous concrete.

In-house research is often done with teams composed of the department's research and operating personnel; each team is assigned a principal investigator. At times M & R assigns a member of its staff to assist in the initial preparation of a project. A portion of the work of the department's M & R field research units is tied to the overall effort to obtain a rapid diffusion of new techniques. These units provide for the field testing of new techniques and products. The testing allows for implementation of the contracted research findings and also provides an opportunity for additional improvements.

M & R and the department's fiscal management unit conduct regular audits and post audits on all state research projects. The same budgetary guidelines are applied to in-house and contracted research activities. Both types are held to well-defined objectives and to budgets; projects which seem unlikely to achieve their stated research objectives can be terminated.

M & R has developed a research manual which outlines the department's procedures for project determination, review, and authorization. This bureau is also responsible for dissemination of research findings. It receives the findings from contracted projects, and then

transmits them to appropriate individuals in the relevant operational units.

There does not appear to be any close correlation between the quality of a state's research program and the quality of its highway system. One reason given for this is that states differ in their highway needs and in the emphasis they place on different components of their highway systems. Some states emphasize interstate and primary roads, others emphasize secondary roads, and others attempt to achieve a balance of the two in their systems. Also, ideally, the findings of research done in any one state should have as much benefit to other states as they do to the state which conducted the research. Thus, "prudent" management might be able to rely on others to bear the expense of generating new knowledge. Obviously, if all states followed this policy no research would be done. Equity would seem to demand that a few states not end up carrying the entire research burden. It is this indivisible aspect of the production of research which has led some to suggest that research must be organized on a national basis, either through a federal agency or through some form of cooperative arrangement.

On the other hand, there is a feeling that current research originating at these levels is often too general for specific application to any given state's operations. Consequently, each state must do its own research and development work if basic solutions are to be applied to the great variety of demands and situations which characterize the highway programs of the different states. Also, management is unlikely to be appreciative of and receptive to research and

development work done outside the state, unless research and development are also considered sufficiently important to be an integral part of that state's operations. The more a state is aware of the contributions of research activity elsewhere, the more it apparently is willing to undertake on behalf of its own specific needs.

A strong effort is made in Pennsylvania to mesh the state's research program with those being undertaken by national, state, and private highway organizations. At the federal level, highway research is performed by the Bureau of Public Roads in the Department of Transportation. The National Council of Highway Research Planning (NCHRP) serves as a clearinghouse for research programs and also supports research projects. State highway departments, acting through the American Association of State Highway Officials, propose studies to NCHRP, which, in turn, can finance research with funds received from the states' 1-1/2 percent allotment.

State highway departments have also joined on occasion in cooperative research projects, usually on problems of regional concern. Pennsylvania is presently engaged in such a project with other northeastern states on the properties of curved girders. These cooperative programs are usually of an ad hoc nature. The Portland Cement Association and the Asphalt Institute also provide basic research information to the state highway officials, who then must decide the applicability of these findings to the state's highway needs. Most of the Bureau of Public Roads' in-house research also reaches state highway departments in a similar "raw" condition.

Department of Labor and Industry

Support for research in the Department of Labor and Industry is derived from General Fund appropriations and from federal agencies. Research is carried out within the Research and Statistics Division of the Bureau of Employment Security, and in the Bureau of Research and Statistics.

The Bureau of Research and Statistics is chiefly concerned with the collection and analysis of data relating to industrial activity within the state. It has performed several in-house research projects in response to requests from universities, various state agencies, and the general public. These studies were provided without cost as public services. A limited amount of research is also undertaken to improve and refine existing programs. However, no special or contractual research projects involving other than departmental funds have been undertaken. The bureau's limited research activity has been attributed to lack of funds and staff to design the research projects, rather than to lack of interest or qualified personnel. Research opportunities of the type which appeared in the past have had to be turned down because the bureau's staff is fully occupied with existing responsibilities. All the bureau's work is performed by its own staff.

The Bureau of Employment Security is engaged in three types of research projects. The first type concentrates on the effects of

unemployment compensation payments; the second attempts to relate the characteristics of recipients of unemployment compensation to problems of designing a program for such individuals; and the third concerns specific problems of given labor markets within the state. Research is supported by federal funds, originating primarily in the U. S. Department of Labor. The bureau has also performed special studies for federal agencies--the Bureau of Labor Statistics and the Department of Commerce--on a contractual basis.

There is no formal procedure within the Research and Statistics Division to determine what projects will be initiated. Most existing research is of a long-standing, continuous nature, although several special projects have been conducted. Suggestions for new studies originate from three sources. First, and most importantly, federal agencies can suggest (and assign) projects or pilot studies to the division. Second, the division's staff can develop research proposals for submission to the appropriate federal agency. Finally, the governor and the secretary of labor and industry can order studies.

Almost all of the department's research is performed on an in-house basis; only two studies have been contracted within the past five years, each a labor market analysis paid for with federal funds. One was performed by The Pennsylvania State University (on the Johnstown labor market), the other by Temple University (on labor force projections). University researchers were selected because they had resources exceeding those of the department. Research guidelines and control procedures for these contracted projects were based on standard federal policies.

Dissemination of the results of the Research and Statistics Division's studies occurs in the form of its reports to other interested state and federal agencies. Some reports are published and disseminated, primarily through the Bureau of Employment Security; others are sent to the federal agencies which contracted for the studies, and which take responsibility for final publication and dissemination.

Department of Mines and Mineral Industries

Research activities of the Department of Mines and Mineral Industries are handled primarily through the Coal Research Board (CRB). The board was established in 1956 with an initial charge to find new markets for Pennsylvania's coal. Since then the enabling legislation has been amended to broaden the scope of the board's research areas. By legislation, membership on the board is assigned to representatives of the anthracite and bituminous coal industries, labor representatives from each of these industries, and one representative each from the steel and electric power industries. Appointed by the governor for four-year terms, members serve without salary. The secretary of mines and mineral industries acts as chairman.

The board serves primarily to determine research needs. Preparation of research proposals and the actual administration of research projects are handled by the director of coal research. Thus the department has a formalized procedure for administering research although it performs little research itself.

Funds for coal research are derived from three sources: annual legislative appropriations, contracts with federal agencies, and contributions from private industry. Annual legislative appropriations for the board have ranged from $37,500 to $500,000, the latter figure reached during the years 1963-67. Since then the state's appropriation

has declined annually. The board sought $1 million for the 1969-70 fiscal year. The governor's office reduced this request to $350,000 in its formal budget; the legislature appropriated $300,000. The cut at the executive level was regarded as disproportionate to reductions made elsewhere in the General Fund budget and was felt to reflect the annual budgetary difficulty of having to fund operational programs, often mandated, before "discretionary" programs, such as research. Thus when budgetary cuts were made, most affected the discretionary programs. (The governor's General Fund budget for 1970-71 provided no funds at all for the Board's activities.)

Funds from the federal government come from several agencies. At present these include four in the Department of the Interior--Office of Saline Water, Federal Water Quality Administration, Office of Coal Research, and Bureau of Mines--and one within the Department of Health, Education, and Welfare--the U. S. Public Health Service. These funds are for both the board's own proposals and those on which the board acts as intermediary for other investigators. Most federally funded proposals involve some state matching funds, which are provided by the board. Although a 75-25 federal-state contribution is the most common sharing arrangement, the matching agreements have ranged from 90-10 to 50-50 federal-state shares. Present federal-state contracts range from a $15,000 study to one for $1.4 million, the latter involving a 50-50 match. Federal-state contracts since 1956 have totalled $6.7 million (Table II-5).

TABLE II-5

Department of Mines and Mineral Industries
State-Federal Research Programs
1966-1969

Federal Agency	State Share	Federal Share	Total Project
U. S. Bureau of Mines	$ 390,533	$1,114,806	$1,505,339
Office of Coal Research	96,525	289,575	386,100
U. S. Public Health Service	269,283	1,072,638	1,341,921
Federal Water Pollution	1,263,008	2,264,497	3,527,505
Totals	$2,091,349	$4,741,516	$6,760,865

This ability to provide matching funds is regarded by the Coal Research Board as a major reason why Pennsylvania has received such a large proportion of federal funds for coal research activities. Moreover, the matching arrangement has provided the board with a mechanism by which it can promote research in areas which it regards as important but for which it cannot provide all necessary financial support. Although it has occasionally been said of matching arrangements that certain state activities have been misdirected in pursuit of "cheap" federal dollars, it would appear that in the case of coal research, the board's standing with federal agencies has permitted it to direct federal research activities along lines of interest to the Commonwealth.

One other unusual feature of the board's relationships with federal agencies is that it has been approached by these agencies to finance their projects. This has occurred when a federal agency such

as the U. S. Forest Service or the U. S. Geological Survey has sought to undertake a research project which would be of relevance to the Commonwealth but for which funds within the federal agency were not available.

The existence of a research board drawn from the industry provides for a project selection mechanism that presumably directs research activities toward the needs of the industry. There have been significant shifts both in the board's method of selecting research projects and in its ordering of research priorities. During the first ten years of the board's operation, the larger portion--as much as 75 percent--of the projects it approved were unsolicited proposals, usually from universities. More recently, the board has adopted a general policy of first determining research needs and then issuing requests for proposals to interested researchers. This shift reflects dissatisfaction with the earlier system, based somewhat on the view that the funded research, even though screened and approved by the board, was too "basic." The CRB mandate is clearly in the applied research area, although most of its projects are felt to have produced new technical information. The board continues to fund unsolicited proposals when they fit within its broad research program.

An administrative problem encountered with proposals has been an increase in the amount of central control over research projects. The Office of Administration has generally insisted that agencies issue requests for proposals on all contracts. This has put the agencies, including the Coal Research Board, in the awkward position of receiving unsolicited proposals, finding that they fit within their research

priorities, and yet not being allowed to enter into a research contract with the individual submitting the proposal without first issuing a general request for proposals.

The research orientation of the board has changed since 1956. Initially its funded research related to the marketing of coal. This emphasis was attributable both to the enabling legislation and the economic conditions of the mid-1950's, which saw the decline of traditional markets for the Commonwealth's coal industries. Emphasis has changed noticeably since then, first to improved transportation techniques for coal, then to techniques for controlling pollution and the economical use of coal by-products, and more recently to improvements in mine safety. These shifts have reflected changing economic conditions for the industry, and general public pressures on the board, with the secretary of mines and the research director apparently playing leading roles in signaling these moves.

The board operates in the following manner. The director of coal research submits a compilation of the industry's research problems to the board, which determines priorities. Requests for proposals are then issued to university and private researchers. The proposals received in this manner plus those which were unsolicited are subsequently placed before the board, usually at a meeting held late in the summer or early in the fall. Proposals are ranked in terms of their conformity with the board's earlier priorities, and awards are made. Grants are made on a one-year basis, largely because of the annual uncertainties surrounding the board's appropriations from the legislature. CRB allows

private patent rights on its projects, although there is a joint assignment with nonprofit groups.

Administration of a contract is handled by the director of coal research, and project reports are sent to the Coal Research Board. The director of coal research is then responsible for disseminating the research results to those state agencies he believes would benefit from them. CRB also maintains its own mailing list. Although there has been no formal follow-up to study the diffusion of research findings resulting from the board's projects, it is felt that these results have been of value and have been assimilated by firms in the industry.

Part of the research is directed at problems where innovation requires state action. Here the rapid transfer of research findings into operational programs is made possible by the department's possession of readily available funds, which were provided by a 1967 bond issue. Thus Mines and Mineral Industries is in the singular position among state agencies of being able to get funding on research relevant to its problems and then being able to fund the capital equipment necessary to implement these findings without having to request funds from the legislature. A recent example of this transfer process was the department's $14 million contract with Westinghouse Electric Corporation to construct a distillation plant to provide potable water to the Wilkes-Barre area. This contract was based upon a 1965 research contract with Westinghouse to study the feasibility of using flash distillation techniques to cope with acid mine drainage.

In addition to availability of funds, the transfer process is facilitated by the fact that the director of coal research is responsible

both for preparing and overseeing the department's research program and for furnishing technical advice on the use of the department's bond issue proceeds.

Pennsylvania, regarded as a leader among the states in coal research, is the only state which matches federal funds. The 1967 bond issue also has been taken as an indication of the Commonwealth's commitment to the solution of its environmental problems. This commitment and the state's technical competencies in coal research are given as the reason why the bulk of federal research funds in this area funnel through Pennsylvania. Only West Virginia, of the neighboring "coal" states, has a systematic research program. There, however, coal research is carried out by the University of West Virginia, and appears as a line item in the state budget. That state also has a Coal Industry Advisory Committee, which serves primarily to screen the choice of research projects carried on within the state's agencies.

Department of Public Welfare

The Department of Public Welfare is organized into four divisions: (1) Executive and Administrative; (2) Family Services; (3) Medical Services and Facilities; and (4) Mental Health and Mental Retardation. Presumably some research is conducted in each division, but department personnel and research staff of the Center for the Study of Science Policy were able to identify or retrieve information on only a few research projects.

In the Executive and Administrative Division, the Office of Planning has broad responsibility for coordinating or conducting department research programs, special analytic studies and surveys of programs, policies and operations, and collecting program and fiscal data for use in decision-making processes and for preparation of required federal reports and departmental reports and investigations. However, funding limitations have restricted the activities of this office to data collection and program surveys.

Little or no in-house research has been conducted in the last four years. Contract research in fiscal 1968 totaled $378,023. (This amount does not include four contracts involving management audits and data processing implementation which totaled $269,400.) Contracted research in 1968 involved a survey of medical personnel at selected state institutions ($41,760), a public welfare system study to establish a

pilot project in four counties ($220,000), and a study of the separation of service from the determination of eligibility ($116,263). Further information on selection, control, and dissemination of research findings was u

The Office of Family Services includes a program of service to the aging and elderly. According to the 1970 Digest of Federal Assistance to Pennsylvania, this office receives federal support under the Older Americans Act of 1965. Title III of the act provides money for improvement and demonstration projects; Title IV provides funds for research and development programs. Between fiscal 1967 and 1969, the Office of Family Services received $125,760 in federal funds under Title IV on a project grant basis. The funds are administered by the U. S. Department of Health, Education, and Welfare (HEW) and matched on a variable basis, with up to 90 percent federal participation possible. State funds used under this program totaled $4,418 between 1967 and 1969.

Other federal programs in the Office of Family Services which may contain research components include public assistance demonstration projects (Social Security Act) and vocational rehabilitation innovation projects (Public Welfare Code Act No. 21 of June 13, 1967).

An estimated one million persons in Pennsylvania are in need of some type of mental health care or treatment, but at present, care is available from all public and private sources for only 235,000. The Office of Mental Health operates twenty state-owned institutions for the mentally ill. Five of these institutions do some research and one, the Eastern Pennsylvania Psychiatric Institute (EPPI), is specifically charged with the responsibility for maintaining a special research and

training center in mental health. In addition, the Pennhurst State School and Hospital for the Mentally Retarded has a research program designed to improve diagnostic capabilities. The research activities of all six of these mental institutions are covered in the description of EPPI which appears at the end of Part II. In 1967, the Bureau of Research and Training in the Office of Mental Health and Mental Retardation was moved to EPPI. This change allowed for the scientific expertise of EPPI to be brought to bear on the problems facing state institutions for the mentally disabled and the developing community mental health centers. The bureau is responsible for coordinating mental health and mental retardation research and training programs throughout the Commonwealth.

In addition to these programs, the Office of Mental Retardation has received money for mental retardation studies under the Public Health Service Act. These funds are administered by HEW on a project grant basis with a minimum of 5 percent cost showing by the state. Total funds reported by the 1970 Digest of Federal Assistance to Pennsylvania include:

	Federal	State
1968-69	$22,893	$9,810
1967-68	19,860	8,510

The Office of Medical Services and Facilities develops policies for the medical assistance program which pays medical costs for the indigent and reimburses hospitals for long-term care for the indigent; operates a system of inpatient and outpatient medical services through the operation of ten state-owned general hospitals and two restoration

centers; establishes standards and supervises or licenses all general hospitals and other related health care facilities, including nursing homes; reviews plans for construction of all hospital and medical facilities; and supervises federally-aided construction.

No research projects were reported in the Office of Mental Services and Facilities, directly or through the Digest of Federal Assistance to Pennsylvania.

State Planning Board

The State Planning Board, created by legislation in 1934, has, since the late 1950's, been located in the governor's office. Membership on the board is assigned by law to five designated cabinet officers, six members of the legislature, and thirteen individuals appointed by the governor.

The board has received a broad legislative mandate to undertake planning studies over a wide range of the Commonwealth's activities. Its recent focus has been concerned with strengthening the planning process in state government; formulation of a statewide comprehensive development plan; functional and regional planning; and establishment of priorities as the basis for action. Major activities are devoted to planning studies and analyses. Another significant portion of its efforts involves staff functions relating to coordination, review, and liaison for various state programs. Minimal research is also involved. The board is charged with developing the capital programs for the state, and, in connection with this responsibility, it becomes familiar with the plans and requirements of other state departments.

The annual planning and research programs of the board's professional staff is initially developed as part of the board's budget request by the executive director, the assistant director, and the staff division heads. Potential projects reflect priorities expressed by the

governor and the board itself, policy and program concerns of the legislature pertinent to state planning, and the staff's knowledge of the areas which are of interest to other state departments, based upon information obtained in the formulation of the capital program and other interdepartmental activities. This annual program is reviewed by the State Planning Board and then by the Office of Administration (OA). The latter review is in the context of the OA budget recommendations to the governor.

The board's program is screened by the legislative appropriations committee, with the main legislative review concerning the size of the board's budget. Although the committee has not urged changing the board's program in any substantial way, it has cautioned the board to avoid duplicating the planning activities of other departments. Legislative acceptance of the board's program is partially based upon what amounts to a form of pre-clearance when the annual program is approved by the State Planning Board, which includes members of the legislature.

On occasion, the legislative thrust appears to be in the direction of increasing the board's responsibilities, occasionally to the point of attempting to convert it into an administrative agency, particularly in the area of environmental protection.

The board's activities are supported primarily by General Fund appropriations. It has also received federal funds under the Appalachia program and under the "701" Planning Assistance Program administered by the U. S. Department of Housing and Urban Development. The bulk of the board's work is performed by its own professional staff. Subcontracts

are entered into or consultants brought in to assist the staff when a study is deemed to require expertise not possessed by the staff. The board does not, in general, fund unsolicited proposals. It does, however, attempt to encourage the activities of regional planning organizations. To do this it has entered into purchase-service agreements with several of these agencies, under which the regional organizations are responsible for a portion of the work required by the board in its formulation of statewide policies and plans. The board also works closely with other state departments in formulating plans which cross departmental lines, e.g., the state's recreation and water resources plans and comprehensive health planning.

The board has also considered the possibility of developing temporary personnel exchange arrangements with other state departments and with regional planning associations as a means of providing additional training. At present no definite proposals to establish such an arrangement have been developed. The board does attempt to develop specialized expertise in its own staff by having individuals assigned to cover specific departments and regional groups.

The board's responsibility for coordinating activities of other state departments appears to have been enhanced by the Intergovernmental Cooperation Act and recent directives of the U. S. Bureau of the Budget (e.g., A-95). Under these new policies, a state agency must submit its proposals for certain federal funding to the State Planning Board to insure the consistency of the department's request with the state plan. This review procedure was initiated in 1969. An extension of this policy to all federal grant programs could place the State Planning

Board in a position of reviewing (with implied powers of disapproval) all federal-state programs, including those that provide research support to state agencies.

State Planning Board
State and Federal Funding

	State Funds		Federal Funds
1965-66	$ 397,713		$ - 0 -
1966-67	500,000		- 0 -
1967-68	609,649	Section 701, U. S. Housing	43,853
1968-69	686,183	Appalachia Section 701, U. S. Housing	75,000
1969-70	1,800,000*	Section 701, U. S. Housing Outdoor Recreation	267,000 40,000
		State augmentation from the Department of Transportation to Topographical and Geological Surveys	142,000

*Governor's Recommended Budget

*The Bureau of Topographical and Geological Surveys joined the State Planning Board in January 1969, when the Department of Internal Affairs was abolished.

State Police

Research activities within the state police are primarily centered in the Planning and Research Division. Research support comes from motor license and General Fund appropriations, with additional funds provided by federal programs. Research is performed in-house; consultants and advisors are occasionally brought in to assist in specific projects, but generally not on a contractual basis.

Within the department there is no budget dedicated to research and development expenditures. Planning and Research Division expenditures exist in the form of salaries which are included in the total budget for administration.

Research projects are closely tied to the operational problems of other divisions within the state police. Proposals for research reach the Planning and Research Division through one of three routes: (1) a particular division or bureau may have a research problem, a statement of which is passed up through the bureau to the commissioner of the state police, who then assigns it to the Planning and Research Division. (2) An extensive program exists to solicit statements of research problems from field and command personnel. Problems elicited through this program are passed on through the bureau director, to the commissioner, and then to the Planning and Research Division. (3) Research projects may originate in the offices of the commissioner and

the chief of police. These projects are passed directly to the research division.

It has not been felt necessary to institute formal procedures for reviewing, ranking, and selecting research projects. For the most part, project selection is made in the office of either the commissioner or the chief of staff, who then assigns projects to the division. Once projects have been approved by the commissioner, decisions on priorities are made by the division head, who is also responsible for administering and supervising the research. Since all research is in-house, and daily contact with each project is possible, there are no formal procedures for monitoring research.

Dissemination and implementation of research findings occur in two ways. Publishable results are distributed in the form of reports to the legislature, public, and other law enforcement agencies. Projects relating to internal matters within the state police are summarized in published reports which are sent to the commissioner and disseminated to the field.

Some examples of the types of projects undertaken by the division are development of program data regarding an expanded complement; development of program data concerning a data communications program; development of field operations manuals--e.g., community relations, line inspection, helicopter patrol, driver licensing; results of staff studies--e.g., interstate patrol technique/establishment of an interstate troop, feasibility of employing women driver examiners, identification of patrol vehicles.

Civil Service Commission

Research and development activities within the Civil Service Commission are located in the Bureau of Examinations, and take place either in the Division of Research and Special Projects or in the Division of Evaluation.

All funds for research and development come directly from the commission's general budget. These funds can derive from numerous sources, as each state agency that makes use of the commission's services contributes toward its operation. Therefore, state agencies that are totally funded by the federal government, such as the Bureau of Employment Security, contribute federal funds to the commission. Occasionally the Civil Service Commission provides personnel services, which can include research and development, to city and county governments in Pennsylvania. In such cases the local governmental units pay the commission directly for the services performed.

The Division of Research and Special Projects was established in September 1968, as an offshoot of the Division of Evaluation, which up to that time had been responsible for all research and special projects conducted by the commission. Until recently about 50 percent of the work performed by the Research and Special Projects Division paralleled work being done within the Evaluation Division. As of August 1970, the Division of Research and Special Projects began concentrating its efforts on research.

The main functions of the Division of Research and Special Projects are

1. Develop and implement programs to identify and obtain information on social science research which is applicable to personnel selection. Evaluate and test, if necessary, the findings of such research and propose changes to Civil Service Commission operations.

2. Perform personnel research to:

   --evaluate the effectiveness of current personnel selection methods
   --improve current methods
   --develop new methods and techniques.

3. Encourage and assist other Civil Service Commission organizational units, graduate students, educational institutions, and other agencies to conduct personnel selection research studies of value to the Commonwealth.

4. Perform special project assignments as directed by the administration.

Almost all of the research problems studied by the Division of Research and Special Projects come from areas within the Civil Service Commission. Priority decisions about which research problems are taken on are currently made by the bureau chiefs and the head of the commission. Research and Special Projects is presently developing new guidelines for establishing research priorities.

Most research handled by the Civil Service Commission has been problem oriented, and the bulk of it is done in-house. Limited use is made of consultants, and then they are employed primarily to develop tests. The division spent an estimated $20,000 on in-house research in fiscal 1969. The U. S. Department of Health, Education, and Welfare and the U. S. Civil Service Commission have provided numerous services to the Research and Special Projects Division in the past. This federal assistance has been in the form of cooperation on studies. No joint federal-state research projects have been undertaken.

The Division of Evaluation, which constructs all examinations for and evaluates all applications from prospective state employees, concentrates more on development than on research. This division continually evaluates existing testing methods, and also develops new tests as they are needed.

Working within the framework of a master annual examination schedule, the work load here is large (more than 175 examination programs and over 50,000 applications per year). The research aspects of work in this division are concentrated on the practical applications of sound test development procedures and the application of test performance measures to the construction of better tests. Emphasis is on developing content validity through the use of program consultants from agencies using test results.

The funding of the Evaluation Division as well as the implementation of results of its work are the same as in the Division of Research and Special Projects.

Crime Commission

Board of Probation and Parole

Both of these agencies are part of Pennsylvania's criminal justice system. The Crime Commission, within the Department of Justice, is a research and planning unit charged with developing and proposing new legislation dealing with crime and crime prevention. The Board of Probation and Parole is responsible for the rehabilitation and supervision of persons on probation or parole.

The Bureau of Planning, Research, and Statistics within the Crime Commission gathers statistics and conducts research and planning. The research unit of this bureau evaluates grant proposals from public or private agencies under the federal Omnibus Crime Control and Safe Streets Act of 1968 (Safe Streets Act). These grants are administered at the federal level by the Law Enforcement Assistance Administration (LEAA) in the U. S. Department of Justice. Several hundred projects have been initiated in the state seeking innovative answers to the present crime situation. Approximately 85 percent of the projects are being conducted by local government units and the remainder by profit and nonprofit private organizations.

The Research and Planning Bureau evaluates each proposal in light of the priorities in the Crime Commission Comprehensive Plan, ensures that each project contains a research design, and monitors

the progress of each project. In fiscal 1968-69, approximately $1.4 million was made available in federal funds for law enforcement assistance in Pennsylvania, excluding $881,650 for support of the state's Criminal Justice Program.

Research within the bureau concentrates on development and evaluation of existing programs through survey research and analysis of criminal justice data. Pilot research projects at the state level are undertaken; these are on the order of the following, conducted in fiscal 1969:

	Federal	State
Corrections Research	$10,000	$6,667
Juvenile Delinquency Research	5,000	3,333
Alcohol and Narcotics Research	6,000	4,000
	$21,000	$14,000

Funds are matched on a 60 percent federal-40 percent state basis. In addition, the National Science Foundation survey on state R & D expenditures for fiscal 1968 reported research expenditures by the state police of $18,400, including $5,400 in federal funds. The low level of research expenditures is partially attributable to the organization of the federal programs.

The orientation of the Safe Streets Act encourages planning projects initially and research at a later point in time. It is felt that in this manner action projects get off the ground and serve to stimulate research.

The Board of Probation and Parole does not have a research program as such and has been unable to obtain funds necessary for even

development of basic data. One research project was conducted in 1968-69 using a grant from the Safe Streets Act. This grant was on a matching basis, with the LEAA supplying $63,000 and the state General Fund providing $31,000. The research project concerned the resocialization of the paroled, nonaggressive predatory offender (burglary, larceny, and forgery). The University of Pennsylvania provided the research consultants and carried out the research, in conjunction with board personnel. The project had a duration of fifteen months.

Research-oriented programs in the area of criminal justice are relatively new. However, both agencies stress the need for development of basic data on criminal justice if new and existing programs (action or research) are to be successful. In the case of the Crime Commission, a reporting system is being developed. The Board of Probation and Parole reported that its lack of basic data has been due to indifferent response from local governments and insufficient funds at the state level for collection purposes.

Fish Commission

Activities of the Fish Commission, including research, are financed from federal aid for fish restoration and recreation, license sales, fines and penalties, and other state revenues, including Project 70 and Project 500 funds. Research programs are financed, in part, by federal-state matching funds. Projects funded through the Bureau of Commercial Fisheries and Bureau of Sports Fisheries under the Anadromous Fish Act of 1965 are matched on a 50-50 federal-state basis. For the last four fiscal years, the following amounts were appropriated to research projects:

Anadromous Fish Act
Research Appropriations

F.Y.	Federal	State
1969-70	$37,250	$37,250
1968-69	30,750	30,750
1967-68	6,750	6,750

Projects funded through the Bureau of Commercial Fisheries Act, on a 75-25 federal-state basis, were as follows:

Commercial Fisheries Act
Research Appropriations

F.Y.	Federal	State
1969-70	$100,125	$33,375
1968-69	25,462	8,488
1967-68	16,144	5,381

Finally, projects funded through the Wildlife Restoration Act (Dingell-Johnson funds), on a 75-25 federal-state basis, were:

Wildlife Restoration Act
Research Appropriations

F.Y.	Federal	State
1969-70	$31,125	$12,375
1968-69	11,250	3,750
1967-68	11,250	3,750

The above acts also provide considerable funds for acquisition and development of recreation facilities.

There have been eight federally supported research projects in the past three years. Several of these have involved attempts to reactivate past sport and commercial fishery interests in Lake Erie (coho salmon, blue pike), the Delaware River (shad, herring, striped bass), and Brandywine Creek (shad). The last two projects are cooperative efforts involving several states. Others are aimed at specific problems (whirling disease, insecticide accumulation) and propagation techniques (warm and cold water rearing in silos).

Selection of projects is made by the staff of the commission's Division of Fisheries and, in some cases, local sport and commercial interests are consulted. Every federally supported study requires a project statement and agreement for each year of the project. Federal assistance may be given for up to three years, but project agreements are made for one year at a time. Each project has a federal coordinator, and reimbursement occurs when the study is completed.

Most of the federally supported research has been performed in-house, and only two research contracts have been let in the past four years. In fiscal year 1968-69, $15,000 of Commercial Fisheries funds were spent on contract research and in 1969-70, $12,000. The Cooperative Fisheries Unit at The Pennsylvania State University also coordinates its research with the Fish Commission. The necessary investment in research facilities probably explains why so little research has been contracted out.

Federally supported research does not constitute the whole of research activities in the Division of Fisheries. State funds have been spent on cultural and other fish research for which no reimbursement was received as follows:

In-House
Research Expenditures

F.Y.	State
1969-70	$ 94,071
1968-69	132,585
1967-68	230,070
1966-67	209,466

Research findings are disseminated through the magazine Pennsylvania Angler and in fishery and scientific journals, including the Dingell-Johnson Quarterly published by the U. S. Fish and Wildlife Service.

In summary, research in the Fish Commission concentrates on sport and commercial fish development within Pennsylvania, but in several cases, cooperative efforts with other states have taken place

or are in progress. Although the commission receives most of its funds from the earmarked state Fish Fund and federal acts, it does not operate entirely independent of state and federal decision makers. Austerity programs at the state level could restrict the hiring of personnel, while changes in federal funding priorities could also affect the amount and allocation of supporting funds.

Game Commission

Research activities within the Game Commission are concentrated in the Division of Research. Development activities take place within the Division of Land Management and relate primarily to game land development.

The Division of Research is funded jointly by the state and federal government. Under the Pittman-Robinson Act the federal government contributes 75 percent of the expenditures, the state 25 percent. The state share does not come from the General Fund, but is allocated from the state Game Fund, a special fund of monies received from license fees, fines, and other game sources.

The Division of Research concentrates its efforts on numerous ongoing projects related to game animals and birds in Pennsylvania. About 75 percent of its work falls into the category of research; the rest is primarily data collection and statistical analysis with direct management application.

Two types of research problems are handled in the Division of Research. The first involves emergency projects that could result from some recent activity or finding that requires immediate attention by the Game Commission. An example would be the finding that there had been a drastic and sudden reduction in the number of some game species. This problem would be brought to the division by a field agency seeking to

know why this reduction had occurred, and what might be done to improve the situation. The second type of project is a continuous attempt by the division to generate more complete information about life histories and population dynamics of game birds and animals within the Commonwealth.

Because most investigations conducted by the Division of Research are long-term studies, there is not a large turnover of projects. However, when a new project is suggested, either by individuals within the Game Commission or by outsiders, it is subjected to a standard screening process. First, a prospectus of the project is developed by the Division of Research, which subsequently forwards it to the commission for approval. If approval is obtained at this level, the proposal is then passed on to the U. S. Department of the Interior for final approval before adoption. Projects funded solely by the commission from the state Game Fund do not require approval of the Department of the Interior.

The majority of research done is conducted in-house. The division does, however, provide an annual grant to the Cooperative Wildlife Research Unit at The Pennsylvania State University for continuing research on specific problems. Occasionally the Game Commission has hired individual consultants in highly specialized fields from Penn State and other institutions of higher learning.

Control and implementation of findings are achieved through job status and job completion reports which must be submitted to the federal government. These findings lead to policy decisions at the state level and often result in abstracts or publications in the state Game News or other professional journals.

Bureau of Topographical and Geological Surveys

The Bureau of Topographical and Geological Surveys (BTGS) is located within the State Planning Board. The Bureau is charged with the execution of all state geological and mineral resource surveys, ground water surveys, and the preparation and updating of topographical maps. No demarcation within the bureau has been drawn between those of its projects which could be classified as research and those which reflect its ongoing survey activities, although the latter constitute the major part of the BTGS program.

Project selection is made by a planning and research committee comprised of six members: the state geologist, who serves as chairman, the assistant state geologist, and four division heads of BTGS. The committee, which determines all priorities for BTGS, meets monthly to review every proposal for BTGS activities--state, private, and cooperative state-federal projects. In regard to topographical mapping, priority determination is quite routinized and formal. An annual questionnaire is sent out to all state agencies asking them to submit their new or revised needs for topographical mapping. Then, in accordance with a predetermined arithmetic formula, authorization is given to as many proposals as possible with the funds allocated by the legislature.

Other aspects of BTGS activities are not as formally determined. The committee looks for written requests from staff members and private sources, but, in particular, for written requests which seem to reflect a pattern of needs. The services of the bureau are increasingly solicited by planning agencies throughout the Commonwealth. The committee has decided to expend more effort in anticipating these needs. It has contacted all known planning agencies in the state, informing them of the data and services which they can provide for producing regional or local plans.

Almost all the bureau's work is performed by its own staff. In 1968, the total BTGS expenditures for extramural contracts were $10,300. These contracts were entered into either to offset manpower shortages or to secure special expertise. Some unsolicited proposals have been received by BTGS, and, although there are exceptions, most have been of a rather low quality.

Private industry does not fund any of the BTGS research work, but there is an active interchange between BTGS and industry with regard to information about and determination of significant problems in the state. The bureau attempts to systematically inform and consult with professional and industrial organizations involved with geological concerns.

No real problem of research duplication seems to exist. A more serious problem is an inadequate capacity for new research. Government officials, particularly at the federal level, are not aware of the data and information already available. Concern over the gap between existing information and limited awareness of these findings at both the

professional and layman's levels has led BTGS to turn recently to much more self-conscious efforts at communication flow among state agencies which need or use geological data. They have also systematically tied into their data collection the information generated by geologists working in and for other state agencies. There are several state agencies which have one or two of their own geologists, usually for regulatory decisions with regard to water supplies for multiple dwelling developments and sewage facilities. BTGS itself does no regulatory work. There is, however, one quasi-regulatory activity: BTGS licenses all well drillers in Pennsylvania. This is not for the purpose of regulation, but is rather an information gathering device. The drillers are required to file geographical reports on what they find while drilling.

BTGS personnel who were interviewed felt the bureau was under great pressure to expand its services without comparable increases in staff. One possible method of expanding the Commonwealth's geological survey capacities would be to incorporate with BTGS the services of the state colleges and universities, which are able and, so it was held, should be willing to assume this role.

At present BTGS emphasizes two programs with the federal government. Both are cooperative projects, specifically defined, continuing, and involving the exchange and sharing of data. In such cooperative projects, both the federal agency and the state agency conduct part of the project. The information is combined, and one of the agencies publishes the results.

The first long-range program is with the U. S. Bureau of Mines (USBM). All USBM-BTGS programs result in the sharing of project results;

there is no exchange of money. There are three ongoing projects with USBM and, from time to time, there are individual projects of limited duration and scope. The three current projects are (1) a clay/shale program which serves as an example of how the project work is divided. The state collects the samples and conducts chemical and physical analyses. The USBM does the application analysis, and then the state publishes the total project results. In short, there is not only cooperative activity, but the cooperation is organized around specialized functions and expertise.

The other long-term federal program with which BTGS is involved is the U. S. Geological Survey (USGS). Here all projects are cooperative, but primarily with regard to financing. The funding for all USGS-BTGS projects is conducted on a 50-50 matching funds basis. USGS does all the field work, analysis, and supplies the personnel; the state provides 50 percent of project costs. There are two major areas of USGS activity, topographical map making and ground water resources studies. Here again, all reports are published jointly. In both the cooperative federal-state programs and the indigenous state programs no data is merely filed in the BTGS office. Everything is published in project reports.

Currently, BTGS is participating in one other federal program, although this involvement is indirect. The Department of Housing and Urban Development funded the State Planning Board to undertake development of a comprehensive state plan. BTGS's involvement has been through the State Planning Board. BTGS has initiated a project to computerize ground water data for rapid retrieval and correlation. This is a one-year

program with terminal objectives. Theoretically, BTGS can try and has attempted to obtain some research funds through the National Science Foundation. However, the limited funds available from NSF were, in the bureau's view, almost automatically funneled to the universities.

The BTGS staff meets regularly with the federal staffs. In the case of USGS, such meetings are facilitated in that the federal office for Pennsylvania is in Harrisburg. Informal meetings are held on an irregular basis, but at least once a week. They are not held to determine projects, but to map out strategies in executing a project--in terms of both division of labor and procedures. The state is totally responsible for project determination. It determines the priorities and sequences it wishes to pursue, and this is true even for topographical mapping. A similar picture applies for the program with the USBM. Here, however, face-to-face meetings are less frequent than with the USGS because USBM has its state office in Pittsburgh. Otherwise, the patterns are much the same with both USBM and USGS.

These cooperative activities involve a very small portion of the total state program. About 95 percent of the geologically related work being done in Pennsylvania is carried out by BTGS itself, and only 5 percent of that work is cooperative. At present the Commonwealth employs 25 geologists; the federal government has 5 geologists working in the state, three of whom are underwritten by Pennsylvania through its 50-50 matching funds. Nationally, federal participation is declining; fifteen years ago the federal government had 20 geologists working in Pennsylvania. However, in states with significant federal land

acreage, there is typically a considerably higher level of federal involvement in state geological activities.

Somewhat of a philosophical divergence is evident at the present time in geology. The orientation of BTGS is to investigate the ways in which geology is related to the environment and the implications this relationship has for planning and development. This is termed "people-oriented" geological activity. It is a perspective in conflict with the classical geological approach, which is basic research and resources oriented and reflects a focus on broad geologic principles and the collection and cataloguing of rocks. USGS is still very much dedicated to this classical perspective. Their activities and concerns are concentrated in an opposite manner to the location and needs of the population centers of the nation. There are 28 federal geologists in the Eastern States Region, which is the most heavily populated region in the nation. It covers the states from Maine to Florida and over to the Mississippi River (except Kentucky), plus Puerto Rico. However, there are more than 400 federal geologists working on lunar geology and the space program.

There are perceived national leaders in geological research among the states. This is not strongly correlated with the level of their funding, although a minimal correlation does exist. The top five states, not necessarily in any specific order, are Pennsylvania, Illinois, Kansas, Alabama, and California.

Eastern Pennsylvania Psychiatric Institute

An act of Pennsylvania's legislature in 1949 created a special research and training center in mental health designated the Eastern Pennsylvania Psychiatric Institute (EPPI). The act further specified that the institute should be built in Philadelphia and should have active affiliation with that city's five medical schools: (1) Hahnemann Medical College; (2) Jefferson Medical College; (3) Temple University School of Medicine; (4) University of Pennsylvania School of Medicine; and (5) Woman's Medical College. The institute's board of trustees, to be composed of three members from each of the five schools, was to function as an administrative board. In past years, the board has traditionally included presidents of the medical schools and universities, deans of the schools of medicine, vice-presidents for medical affairs, and prominent lay members of the boards of trustees from these five schools.

The enabling act also provided for the establishment of a medical advisory board composed of the professors of psychiatry in the five affiliating medical schools. This board was to counsel the board of trustees on staff appointments, patient care programs, and all research and training activities. The two bodies were constituted following enactment of the enabling legislation and met actively on a monthly basis through the years of the institute's development.

The institute opened in 1956 and developed a departmental structure to meet the mandates of the founding legislation. These departments will be described below. The institute functions on the principle that productive research, high caliber training, and excellent patient care are inseparable; the goal has been to build a coordinated program embodying the finest traditions associated with these three aims.

In 1967 the enabling act was amended to bring the EPPI more directly into the mainstream of the Commonwealth's mental health and retardation program. The board of trustees assumed an advisory role, and the Bureau of Research and Training in the Office of Mental Health and Mental Retardation was moved to the institute. This allowed the scientific expertise of the institute's staff to be brought to bear on the problems facing state institutions for the mentally disabled and the developing community mental health centers. The Bureau of Research and Training is charged with coordinating mental health/mental retardation research and training programs throughout the Commonwealth.

EPPI is located on approximately sixteen acres in the northwest section of Philadelphia, and is a composite of a highrise, thirteen-story facility, coupled with smaller adjacent sections housing a children's unit, an educational and research center, and a residence for professional staff members.

There are four research departments within the institute:

1. Children's Research Unit
2. Department of Basic Sciences
3. Department of Clinical Sciences
4. Department of Behavioral Sciences

Although each department functions with some degree of autonomy in the selection of research projects, the budgeting of funds is conducted centrally through the medical director and the Commission on Mental Health in the Department of Public Welfare. In the future, an executive committee composed of EPPI's various research and administrative directors may have greater input into the process for selection of projects.

Funds for research are received from both state appropriations and federal grants. The institute appears as a line item in the budget of the Pennsylvania Department of Public Welfare. Roughly 25 percent of state funds are directly used for research purposes. Federal project grants are obtained from such agencies as the U. S. Public Health Service, the National Science Foundation, and the U. S. Department of Defense (Army). On the average, $105,000 has been expended annually in the form of federal contract awards.

Research expenditures at EPPI during the last four fiscal years are as follows:

F.Y.	State	Federal
1969-70	$1,360,776	--
1968-69	1,451,104	$168,814
1967-68	1,354,335	66,151
1966-67	1,128,914	113,805

Federal monies are reported on the basis of the fiscal year during which the award was received; contracts may cover more than one fiscal year. State appropriations include expenditures in the four research departments and an allocation for support for administration, animal colony, machine shop, and inventory. The reported data for fiscal 1969 and 1966

do not include expenditures for research in the children's unit or administrative support (approximately $140,000 annually).

The research departments conduct basic and applied psychiatric research which supports the education l and clinical services of the i- stitute. EPPI, in conjunction with the medical schools, is responsible for the training of individuals in all mental health disciplines. Graduate and medical students receive research training and university staff conduct research projects within the institute.

Research in the children's unit includes the following projects:

1. Research in the treatment of childhood psychosis.
2. A study of motility and perceptual patterns in childhood psychosis.
3. A study of brain-damaged and retarded children's symptoms, diagnosis, and treatment.
4. Research in psychiatric diagnostic categories of children.
5. Countertransference phenomena in work with disturbed children.
6. Symptom study and study of normal personality development.
7. Day care programs for emotionally disturbed children.
8. Videotape as a teaching medium.
9. Children's dreams.
10. Psychophysiological measurements of disturbed children.
11. Research on personality development of underprivileged, deprived children from culturally, socially, economically, and emotionally deprived families.

The aim of the research program in the Department of Basic Sciences has been to develop an understanding of brain functions and

mental diseases. This necessitates dissembling the brain chemically to obtain those components responsible for thought processes and then to reconstitute both cell structure and function. The fundamental problems of brain cell structure and function with particular emphasis on the nerve cell and its action potential are investigated through

1. Membrane chemistry research, including studies of the primary structure of EIM.
2. Physical chemistry research, including molecular structure-function correlation studies.
3. DNA and cell structure research, including studies of nucleic acid metabolism.

There are approximately five professional research staff members in the Department of Basic Sciences, excluding supportive staff composed of biochemical and biophysical technicians.

The Department of Clinical Sciences is comprised of roughly a dozen research groups, each headed by a scientifically independent senior investigator. This department includes psychiatrists, psychologists, physiologists, pharmacologists, and biochemists together with their technical assistants and other supporting personnel. The areas under investigation include

1. psychoendocrinology and biological rhythms
2. creativity and intelligence
3. creativity and perception
4. neurophysiology of evoked responses
5. biology of psychotic behavior
6. pharmacology of neurotransmission in the caudate and amygdaloid nuclei
7. research in psychotherapy

The Department of Behavioral Sciences, established during fiscal year 1968-69, provides a new administration and research organization of the behavioral scientists at the institute. It includes the psychology department, Temple University's behavioral science group, and a number of research scientists and groups occupied with studies in the psychological, anthropological, sociological, psychophysiological, and psychosomatic fields. This new department aims at strengthening behavior research and psychological services, and at serving as a basis from which behavioral research problems throughout the Commonwealth can be approached and resolved through the administrative and communication system provided by the Bureau of Research and Training.

There are about 36 professional research staff members in the department, exclusive of the Temple University group. Research is conducted in the following areas:

1. Nonverbal communication in psychotherapy.
2. Creativity related to affect, ego-defense, and endocrine processes.
3. Psychophysiological aspects of cancer.
4. Projective psychological techniques.
5. Methods by which an evaluative community mental health center functions.
6. Elicitation and analysis of visual imagery sequences.
7. Psychological responses in the newborn infant.
8. Attention span in schizophrenic and nonschizophrenic subjects.
9. Human adaption to abnormalities of calcium and magnesium ion homeostasis.
10. Behavioral studies of administrative structures.

11. Process of mourning in response to suicides and vehicular accidents.

12. Psycholinguistics.

13. Outcome of treatment.

14. Relationship between self-esteem and delinquent behavior.

15. Readiness for treatment.

16. Therapists' understanding of patients in relation to outcome of therapy.

In addition to direct feedback to the students, staff, and patients at the institute, research results are disseminated widely through professional journals and reports to state and federal agencies.

Several other mental health institutions in the Commonwealth also have research programs but on a smaller scale than the EPPI. These include research projects at Harrisburg, Norristown, Pennhurst, and Philadelphia and at the Eastern State School and Hospital at Trevose. Based on National Science Foundation surveys, annual research expenditures in these institutions total $110,000 in state funds and $270,000 in federal funds. In addition, the Commonwealth makes a deficiency appropriation to the Western Pennsylvania Psychiatric Institute which is operated by the University of Pittsburgh. This institution is primarily engaged in training and patient care although some research is conducted.

Appendix A: Data and Data Sources

There is no central estimate of the Commonwealth's R & D expenditures, either in total or even for that portion of the total which is funded by state revenues. Data on R & D expenditures are readily available for those departments which have clearly identified research programs and whose budgets are primarily for the support of research, such as the Coal Research Board in the Department of Mines and Mineral Industries. In most other departments, research expenditures appear as part of the budgets of bureaus of research, planning, and evaluation, with no specific item separation in the budgets on the amounts expended for each of these conceptually separate activities.

In some departments, research activities are supported by earmarked funds arising from formula provisions of federal or state laws. In the Department of Highways, for example, federal programs provide that 1 1/2 percent of the state's total allotment be designated for research and planning, with the division between the two activities resting upon a departmental decision. In Agriculture, research is supported by funds derived from division of the state Harness Racing Fund. In neither of these cases, however, would research expenditures appear directly in any of the Commonwealth's array of budgets.

The identification of research expenditures will eventually be facilitated by the introduction into the Commonwealth's operation of a PPB system. In the governor's program budget for fiscal 1970 research is treated as a subcategory under a few headings. The budget figures are those presented under research and planning in

the conventional administrative budget, or those already clearly identifiable through fiscal 1969 and prior to the complete implementation of a PPB system.

Departmental and commission expenditures were sought for total R & D, for R & D broken down by funding source (state, federal), and for expenditures on contracted and on in-house research. Data were obtained primarily from the research division or bureau within each department. Research bureaus are, however, responsible for the largest share of departmental research in only a few departments (e.g., Health, if one excludes state funds to six hospitals, and Highways), while in others (Community Affairs, Education) a large portion of a department's research activities occur in other bureaus within the department. It was therefore necessary to contact those bureaus within each department which were thought to perform R & D and to obtain from them their estimates on the cost of their activities. These additional bureaus were identified from interviews with the research bureaus and by communication with the controller in each department to determine whether funds were available from any source to support R & D.

This pattern has led to an understatement of state and local research expenditures in the National Science Foundation (NSF) survey on this subject. Survey questionnaires are sent by NSF to that bureau in a department most likely to perform research, which presumably in most cases would be the research bureau. Although the recipient of such a questionnaire might forward it to other research administrators within his department or see to it that they also

receive one, the coverage obtained with such an approach is less than that provided by detailed interviews. The obvious difference, of course, is that the NSF studies have been concerned with all states, while ours has focused solely on Pennsylvania

An attempt was also made to obtain data on departmental contract R & D expenditures through the Office of Administration (OA). Under recent administration directives, OA has been given additional responsibilities for overseeing and monitoring departmental contract research policies. At present, this supervision consists of determining whether a proposed study is necessary, whether another agency is performing a similar study, and whether the Commonwealth has the personnel to perform the study on an in-house basis. In terms of budgetary information, this new management arrangement has not yet been fully implemented. The Office of Administration had only limited information on departmental R & D expenditures for fiscal 1968 and 1969. The information it has presently relates more to consulting contracts than to projects which might be classified under R & D.

A check was also made of the 1970 Digest of Federal Assistance to Pennsylvania, which is prepared by the Commonwealth's Bureau of the Budget, for those federal programs which might have supported the R & D activities of a state department for fiscal 1965-1968. Some programs were identified which seemed to fall within this category, but they were either not identifiable as R & D or not regarded as such by the relevant state department. It was not possible in all cases to reconcile this type of inconsistency, and funds for

federal programs not listed by the state department were therefore not included. This inconsistency is serious only in the case of the Department of Public Welfare, and perhaps accounts for the low amount reported for R & D within that department. According to the "Digest," the department received substantial funds between 1965 and 1969 for improvement and demonstration projects designed to strengthen the state's services to the aging and elderly. The grants included funds for planning, direct services, and the training of personnel, but presumably included some funds for R & D. Similar examples were found in Public Welfare and Education

The final source for the data were the questionnaires completed by departmental personnel for the NSF survey of state R & D expenditures for fiscal 1967 and 1968. Total figures for all states have been published in preliminary form. Although the Center's study attempted to follow the definitions used by NSF in its surveys, it was not possible in all cases, for the reasons noted below. to do this. Our estimates thus differ from those of NSF for several agencies. The NSF survey does contain some expenditure estimates. e.g., Justice Department which we had not obtained they are included in our data and identified as coming from the NSF survey.

Under the definitions employed by NSF in its surveys of state and local expenditures. "research and development (R & D) activities . . . concern experiments or investigations the purpose of which is to discover or interpret facts or to develop practical applications of such research . . . . Research is to be distinguished from fact-gathering. . . . R & D does not include routine project testing,

quality control, and activities concerned primarily with the dissemination of scientific information and the training of scientific manpower."[1]

It was generally possible to adhere to this definition only when a department had an organizationally delimited research program and when the bulk of the funds allocated to this program were expended on contracted research. The activities of the Coal Research Board, Department of Mines and Mineral Industries, and the agricultural research funded through the Department of Agriculture's share of the state Harness Racing Fund fall within this category. In addition, we attempted to double-check the expenditures for R & D reported to NSF in several instances (mental health institutions, Historical and Museum Commission). Apparent inconsistencies could not always be resolved.

In other state departments, various difficulties were encountered in separating R & D activities from consulting, planning, evaluation, and training activities. These categories are more easily distinguished conceptually than operationally, as consulting or planning projects frequently involve some activities which could be legitimately regarded as R & D. This difficulty exists for both in-house and contracted projects. In the case of in-house projects, the expenditures given represent those provided by the department based upon its best estimate. For contracted projects, the expenditures listed represent our estimate of those projects listed by each department which could be considered to entail R & D.

This adherence to an NSF-type definition of R & D had its greatest impact on the expenditure figures recorded in the Office of

Administration, the Department of Community Affairs, the Department of Commerce (Pennsylvania Science and Engineering Foundation), and the State Planning Board. Most of the studies contracted for by OA were regarded as consultant projects and were not treated as R & D. Also excluded from the OA total was the Commonwealth's $315,000 contract with the Institute for Public Administration of The Pennsylvania State University for installation of a PPB system and a $30,000 contract for the initial development of PPB.

Likewise, several contracted planning and program evaluation studies of Community Affairs were not regarded as R & D. The Pennsylvania Science and Engineering Foundation (P-SEF) was established to foster development of the Commonwealth's scientific and technological resources as a means of stimulating economic development. In a sense, P-SEF's entire budget is directed at supporting R & D capabilities, although only a portion is spent on R & D as defined here. It was therefore necessary to omit those projects supported by P-SEF which had as their main stated objective the development of educational or research facilities, e.g., fellowships. The activities of the State Planning Board, not including the Bureau of Topographical and Geological Surveys, were treated as "planning," although parts of its various projects apparently involve work that if performed on a contractual basis would be properly regarded as R & D. For this reason, the expenditures of the State Planning Board are listed separately. Certain planning activities of other departments, as contributions to the State Plan, were also omitted.

Departments estimated their in-house expenditures in some cases on a prorated basis from total project or contract costs. Certain other in-house data (Health, Labor and Industry) were estimated on the basis of fixed percentage changes back to earlier years, using 1969-70 expenditure figures as a base.

Finally, the departmental expenditures suffer from the defect that in almost all departments it was not possible to provide more than fragmentary estimates, particularly for informal in-house research and problem solving, for the years prior to 1969. This limitation reduces somewhat the value of the data in discerning long-term trends in overall state expenditures, expenditures by program area or department, or in policies with regard to in-house or contracted research. Even for the more recent years, it was not always possible to get clear-cut estimates of a department's expenditures This is probably not too serious an omission for those departments recorded as having no traceable R & D expenditures, as it is unlikely that any expenditures of appreciable magnitude would have gone unnoticed. If omissions have occurred, it is likely to be for the departments cited below. There is still the possibility in those departments that because of departmental inability to identify their R & D expenditures, or the ambiguity of the instructions and definitions used in this study, some R & D expenditures have not been included.

The data presented below are in two distinct forms. For each department, one table records R & D expenditures by source of funds, state or federal. In two instances (Education, Mines and Mineral Industries), funds for research were also received from other outside

sources, which are noted below. A second table lists the performer of R & D, department (in-house), university, or other contracting agencies, including federal agencies. Each table is briefly described with respect to the source of the data it contains.

Tables 1a, 1b (Office of Administration)

In-house total project expenditures estimated by department personnel and prorated for annual figures.

Tables 2a, 2b (Department of Agriculture)

Fiscal years 1966-69 include a $16,370 annual contribution in state funds to the U. S. Geological Survey for a study of soil erosion and stream sedimentation control. Division of projects into PPBS program categories estimated from project descriptions.

Tables 3a, 3b (Department of Commerce)

In-house expenditures in the Bureau of Industrial Development estimated at 25 percent of the bureau's Division of Research budget. Expenditure account for the Pennsylvania Science and Engineering Foundation (P-SEF) does not include various projects whose main objective was the development of educational or research facilities. Total P-SEF project grants were as follows:

1969-70	$1,396,439
1968-69	1,263,174
1967-68	1,424,561
1966-67	--

Tables 4a, 4b (Department of Community Affairs)

In-house expenditures in the Bureau of Research and Program Development estimated by bureau personnel. Contract expenditures by the bureau do not include various contracts designed to develop local government manuals, implement legislation, etc. Total contract expenditures were as follows:

1969-70	$171,262
1968-69	203,651
1967-68	11,914
1966-67	--

Department research expenditures do not include various U. S. Department of Housing and Urban Development grants for planning and demonstration projects.

Tables 5a, 5b (Department of Education)

In-house expenditures in the Bureau of Research do not include various projects concerned with development of education bibliographies, etc. In-house expenditures in the Bureau of Institutional Studies estimated by bureau personnel from salaries of research staff.

Federal funds in the Bureau of Research include the following amounts received from the Ford Foundation for a research project on the development and evaluation of an early intervention program for disadvantaged children:

1969-70	$ 13,913
1968-69	24,653
1967-68	16,285
1966-67	109,411

Tables 6a, 6b (Department of Forests and Waters)

Department research expenditures assigned to PPBS program categories on the following basis: protection (Bureau of Engineering), economic development (Bureau of Forestry), and recreation (Bureau of State Parks).

Tables 7a, 7b (Department of Health and Hospital Appropriations)

Department expenditures estimated on the following basis: (1) Bureau of Research budget for 1969-70 reduced by 5 percent for earlier years; (2) Bureau of Behavioral Science 1969-70 research budget reduced by $10,000 annually for earlier years; (3) Bureau of Laboratories 1969-70 research budget reduced by 15 percent annually for earlier years; (4) Bureau of Special Health data not available prior to 1969-70; (5) Bureau of Environmental Health 1969-70 research budget reduced by 15 percent for earlier years; (6) Bureaus of Environmental Control and Public Health expenditures estimated at $12,000 per project for 1969-70 only.

Some U. S. Public Health Service funds used for research may not be accounted for, especially in the Bureau of Behavioral Science.

Tables 8a, 8b (Department of Highways)

Estimated division between state and federal expenditures based on federal formula, 75 percent federal and 25 percent state. Expenditures by performer estimated for 1967 and 1968.

Tables 9a, 9b (Department of Justice)

Expenditures for 1969-70 obtained from the 1969 Pennsylvania Crime Commission comprehensive plan expenditures for 1968-69 based on NSF survey data.

Tables 10a, 10b (Department of Labor and Industry)

Research expenditures estimated at 10 percent of the budget of the Bureau of Employment Security plus contract grants.

Tables 11a, 11b (Department of Mines and Mineral Industries)

PPBS program category expenditures estimated on the basis of project descriptions. Fiscal 1967 federal expenditures included the following amounts for optimization and development of coal mine drainage:

Coal industry	$20,000
United Mine Workers	5,000

Tables 12a, 12b (Department of Public Welfare and Mental Institutions)

Expenditures in the Bureau of Research estimated on the basis of 1968 expenditures only. Expenditures in the Office of Family Services (aging) and the Office of Mental Retardation based on data in the Digest of Federal Assistance to Pennsylvania (1970), pp. 131 and 150. Expenditures for the Eastern Pennsylvania Psychiatric Institute obtained from institute personnel; expenditures in other mental institutions based on correspondence and NSF survey data.

Tables 13a, 13b (Board of Probation and Parole)

Expenditures reported for 1968 only.

Tables 14a, 14b (Civil Service Commission)

Data based on annual salaries of employees engaged in research. Ten percent of staff effort spent in research on personnel section.

Tables 15a, 15b (Fish Commission)

PPBS program category expenditures based on source of federal funds: Economic Development (Anadromous Fish Act, Commercial Fisheries Act) and Recreation (Wildlife Restoration Act). State appropriations, unmatched by federal monies, were assumed to be spent entirely in the Recreation category.

Tables 16a, 16b (Game Commission)

Expenditures based on 1969-70 research budget and reduced by $2,000 per year for earlier periods.

Tables 17a, 17b (Historical and Museum Commission)

Expenditure data for archeological field research only.

Tables 18a, 18b (State Planning Board and Bureau of Topographical and Geological Surveys)

Not included in summary tables (Tables I-1 and I-2). The Bureau of Topographical and Geological Surveys is included for 1969 only. Data represent total planning and research expenditures.

FOOTNOTE

[1]National Science Foundation, R & D Activities in State Government Agencies, 1964 and 1965 (Washington: Government Printing Office, 1967), p. 65.

TABLE 1a

RESEARCH EXPENDITURES BY SOURCE: OFFICE OF ADMINISTRATION
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Personnel Administration	28	--	28	48	--	48	8	--	8	8	--	8
Systems Analysis	60	--	60	60	--	60	--	--	--	--	--	--
Budget	4	--	4	4	--	4	4	--	4	4	--	4
Financial Management	40	--	40	20	--	20	20	--	20	20	--	20
Total	132	--	132	132	--	132	32	--	32	32	--	32

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TABLE 1b

RESEARCH EXPENDITURES BY PERFORMER: OFFICE OF ADMINISTRATION
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Personnel Administration	28	--	--	28	--	20	8	--	--	8	--	--
Systems Analysis	60	--	--	60	--	--	--	--	--	--	--	--
Budget	4	--	--	4	--	--	4	--	--	4	--	--
Financial Management	20	--	20	20	--	--	20	--	--	20	--	--
Total	112	--	20	112	--	20	32	--	--	32	--	--

TABLE 2a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF AGRICULTURE
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Protection	117	--	133	222	--	222	273	--	273	243	--	243
Economic Development	182	--	182	301	--	301	339	--	339	314	--	314
Total	299	--	315	523	--	523	596	--	612	541	--	557

TABLE 2b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF AGRICULTURE
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Protection	--	117	16	6	200	16	7	250	16	7	220	16
Economic Development	10	172	--	4	297	--	3	336	--	57	257	--
Total	10	289	16	10	497	16	10	586	16	64	477	16

TABLE 3a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF COMMERCE
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
P-SEF	540	--	540	931	--	931	683	--	683	--	--	--
Industrial Development	12	--	12	24	--	24	10	--	10	10	--	10
Appalachia	--	121	121	--	114	114	--	--	--	--	--	--
Travel Development	--	--	--	40	--	40	--	--	--	--	--	--
Total	552	121	673	995	114	1,109	693	--	693	10	--	10

TABLE 3b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF COMMERCE
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
P-SEF	--	510	30	--	812	119	--	465	218	--	--	--
Industrial Development	12	--	--	12	12	--	10	--	--	10	--	--
Appalachia	--	--	121	--	--	114	--	--	--	--	--	--
Travel Development	--	--	--	30	--	10	--	--	--	--	--	--
Total	12	510	151	42	824	243	10	465	218	10	--	--

TABLE 4a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF COMMUNITY AFFAIRS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Research	146	--	146	206	--	206	53	--	53	50	--	--
Mass Transportation	--	--	--	--	--	--	101	--	101	--	--	--
Recreation	57	--	57	--	--	--	--	--	--	--	--	--
Local Government	175	30	205	--	--	--	--	--	--	--	--	--
Total	378	30	408	206	--	206	154	--	154	50	--	50

TABLE 4b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF COMMUNITY AFFAIRS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Research	50	40	56	50	25	131	50	3	--	50	--	--
Mass Transportation	--	--	--	--	--	--	--	--	101	--	--	--
Recreation	26	12	18	--	--	--	--	--	--	--	--	--
Local Government	--	--	205	--	--	--	--	--	--	--	--	--
Total	76	52	279	50	25	131	50	3	101	50	--	--

TABLE 5a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF EDUCATION
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Research	32	105	137	258	138	396	176	178	354	153	291	444
Educational Quality	70	105	175	78	173	251	75	--	75	--	--	--
Institutional Study	55	--	55	67	--	67	--	--	--	--	--	--
Curriculum Development	--	--	--	--	72	72	--	--	--	--	--	--
Total	157	210	367	403	383	786	251	178	429	153	291	444

TABLE 5b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF EDUCATION
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Research	105	24	8	294	103	--	198	156	--	184	259	1
Educational Quality	175	--	--	78	67	106	75	--	--	--	--	--
Institutional Study	55	--	--	67	--	--	--	--	--	--	--	--
Curriculum Development	--	--	--	--	50	22	--	--	--	--	--	--
Total	335	24	8	439	220	128	273	156	--	184	259	1

TABLE 6a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF FORESTS AND WATERS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Engineering	62	--	62	68	--	68	80	--	80	45	--	45
Forestry	40	--	40	30	--	30	30	--	30	4	--	4
State Parks	16	--	16	--	--	--	26	--	26	--	--	--
Total	118	--	118	98	--	98	136	--	136	49	--	49

TABLE 6b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF FORESTS AND WATERS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Engineering	--	38	24	--	46	22	--	27	53	--	12	34
Forestry	--	35	5	--	25	5	--	25	5	--	--	5
State Parks	11	--	5	--	--	--	--	--	26	--	--	--
Total	11	73	34	--	71	27	--	52	84	--	12	39

TABLE 7a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF HEALTH AND HOSPITAL APPROPRIATIONS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Research	165	69	234	156	47	203	148	27	175	141	---	141
Behavioral Sciences	69	--	69	60	--	60	50	--	50	40	--	40
Laboratories	250	--	250	217	--	217	189	--	189	164	--	164
Special Health	161	--	161	--	--	--	--	--	--	--	--	--
Environmental Health	193	253	446	164	215	379	139	183	322	118	156	274
Environmental Control	12	--	12	--	--	--	--	--	--	--	--	--
Public Health	24	--	24	--	--	--	--	--	--	--	--	--
Total - Health	874	322	1,196	597	262	859	526	210	736	463	156	619
Hospitals	785	--	785	813	--	813	737	--	737	670	--	670
Total	1,659	322	1,981	1,410	262	1,672	1,263	210	1,473	1,133	156	1,289

TABLE 7b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF HEALTH AND HOSPITAL APPROPRIATIONS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Research	234	--	--	203	--	--	175	--	--	141	--	--
Behavioral Sciences	69	--	--	60	--	--	50	--	--	40	--	--
Laboratories	250	--	--	217	--	--	189	--	--	164	--	--
Special Health	--	81	80	--	--	--	--	--	--	--	--	--
Environmental Health	304	--	142	258	--	121	219	--	103	186	--	88
Environmental Control	12	--	--	--	--	--	--	--	--	--	--	--
Public Health	24	--	--	--	--	--	--	--	--	--	--	--
Total - Health	893	81	222	738	--	121	633	--	103	531	--	88
Hospitals	--	15	770	--	--	813	--	--	737	--	--	670
Total	893	96	992	738	--	934	633	--	840	531	--	758

TABLE 8a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF HIGHWAYS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Research	423	1,268	1,691	344	1,030	1,374	163	488	651	174	522	696

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TABLE 8b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF HIGHWAYS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Research	345	1,226	120	168	1,086	120	155	386	110	199	386	111

TABLE 9a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF JUSTICE
(In Thousands of Dollars)

Activity	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Crime Commission	14	21	35	13	5	18	--	--	--	--	--	--

TABLE 9b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF JUSTICE
(In Thousands of Dollars)

Activity	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Crime Commission	35	--	--	--	18	--	--	--	--	--	--	--

TABLE 10a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF LABOR AND INDUSTRY
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Employment Security	106	139	245	--	137	137	--	241	241	--	131	131

TABLE 10b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF LABOR AND INDUSTRY
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Employment Security	245	--	--	137	--	--	122	119	--	131	--	--

TABLE 11a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF MINES
AND MINERAL INDUSTRIES (COAL RESEARCH BOARD)
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Health	289	405	694	1,236	480	1,716	380	797	1,177	465	290	755
Economic Development	45	57	102	145	--	145	105	--	105	76	--	76
Total	334	462	796	1,381	480	1,861	485	797	1,281	541	290	831

TABLE 11b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF MINES
AND MINERAL INDUSTRIES (COAL RESEARCH BOARD)
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Health	--	--	694	--	855	860	--	195	981	--	350	404
Economic Development	--	--	102	--	40	105	--	40	65	--	6	70
Total	--	--	796	--	895	965	--	235	1,044	--	356	474

TABLE 12a

RESEARCH EXPENDITURES BY SOURCE: DEPARTMENT OF PUBLIC WELFARE
AND MENTAL INSTITUTIONS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Research	325	--	325	378	--	378	350	--	350	325	--	325
Family Services	2	63	65	2	63	65	2	63	65	--	--	--
Mental Retardation	10	20	30	10	23	33	9	20	29	--	--	--
Total--Public Welfare	337	83	420	390	86	476	361	83	444	325	--	325
EPPI	1,501	--	1,501	1,451	114	1,565	1,354	66	1,420	1,269	169	1,438
Other Mental Institutions	139	211	350	112	286	398	94	293	387	94	293	387
Total	1,977	294	2,271	1,953	486	2,439	1,809	442	2,251	1,688	462	2,150

TABLE 12b

RESEARCH EXPENDITURES BY PERFORMER: DEPARTMENT OF PUBLIC WELFARE AND MENTAL INSTITUTIONS
(In Thousands of Dollars)

Bureau	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Research	--	--	325	--	--	378	--	--	350	--	--	325
Family Services	65	--	--	65	--	--	65	--	--	--	--	--
Mental Retardation	30	--	--	33	--	--	29	--	--	--	--	--
Total--Public Welfare	95	--	325	98	--	378	94	--	350	--	--	325
EPPI	1,501	--	--	1,565	--	--	1,420	--	--	1,438	--	--
Other Mental Institutions	350	--	--	398	--	--	387	--	--	387	--	--
Total	1,946	--	325	2,061	--	378	1,901	--	350	1,825	--	325

TABLE 13a

RESEARCH EXPENDITURES BY SOURCE: BOARD OF PROBATION AND PAROLE
(In Thousands of Dollars)

Activity	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Research	--	--	--	31	63	94	--	--	--	--	--	--

TABLE 13b

RESEARCH EXPENDITURES BY PERFORMER: BOARD OF PROBATION AND PAROLE
(In Thousands of Dollars)

Activity	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Research	--	--	--	31	63	--	--	--	--	--	--	--

TABLE 14a

RESEARCH EXPENDITURES BY SOURCE: CIVIL SERVICE COMMISSION
(In Thousands of Dollars)

Division	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Evaluation	25	--	25	22	--	22	20	--	20	18	--	18
Research	20	--	20	--	--	--	--	--	--	--	--	--
Total	45	--	45	22	--	22	20	--	20	18	--	18

TABLE 14b

RESEARCH EXPENDITURES BY PERFORMER: CIVIL SERVICE COMMISSION
(In thousands of Dollars)

Division	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Evaluation	25	--	--	22	--	--	20	--	--	18	--	--
Research	20	--	--	--	--	--	--	--	--	--	--	--
Total	45	--	--	22	--	--	20	--	--	18	--	--

TABLE 15a

RESEARCH EXPENDITURES BY SOURCE: FISH COMMISSION
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Economic Development	71	137	208	39	56	95	12	23	35	4	4	8
Recreation	107	37	144	136	11	147	234	11	245	209	--	209
Total	177	174	351	176	67	243	246	34	280	213	4	217

TABLE 15b

RESEARCH EXPENDITURES BY PERFORMER: FISH COMMISSION
(In Thousands of Dollars)

PPBS Category	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Economic Development	208	--	--	80	15	--	35	--	--	8	--	--
Recreation	132	12	--	147	--	--	245	--	--	209	--	--
Total	340	12	--	227	15	--	280	--	--	217	--	--

TABLE 16a

RESEARCH EXPENDITURES BY SOURCE: GAME COMMISSION
(In Thousands of Dollars)

Division	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Research	37	111	148	36	109	145	36	107	143	35	106	141

TABLE 16b

RESEARCH EXPENDITURES BY PERFORMER: GAME COMMISSION
(In Thousands of Dollars)

Division	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Research	113	35	--	112	33	--	112	31	--	112	29	--

TABLE 17a

RESEARCH EXPENDITURES BY SOURCE: HISTORICAL AND MUSEUM COMMISSION
(In Thousands of Dollars)

Activity	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Archaeology Field Research	15	--	15	13	--	13	7	--	7	8	--	8

TABLE 17b

RESEARCH EXPENDITURES BY PERFORMER: HISTORICAL AND MUSEUM COMMISSION
(In Thousands of Dollars)

Activity	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Archaeology Field Research	13	2	--	13	--	--	7	--	--	8	--	--

TABLE 18a

PLANNING AND RESEARCH EXPENDITURES BY SOURCE: STATE PLANNING BOARD
(In Thousands of Dollars)

Total Budget	1969-70			1968-69			1967-68			1966-67		
	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total	State	Fed.	Total
Planning and Research	1,942	307	2,249	686	325	1,011	610	44	654	500	--	500

TABLE 18b

PLANNING AND RESEARCH EXPENDITURES BY PERFORMER: STATE PLANNING BOARD
(In Thousands of Dollars)

Total Budget	1969-70			1968-69			1967-68			1966-67		
	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other	Dept.	Univ.	Other
Planning and Research	2,249	--	--	1,011	--	--	654	--	--	500	--	--

Appendix B: Commonwealth Research Wage Scale and Number of Employees in Each Level, 1969

Class Code	Pay Range--Title	Number of Incumbents
	27 $6,390-$8,580	
0541	Statistical Assistant	8
	28C $7,407-$9,011	
0857	PPBS Trainee	0
2445	Educational Research Trainee	4
	29B $7,407-$9,454	
3601	Medical Research Technician I	40
	31B $8,163-$10,432	
0121	Systems Analyst I	3
1620	Planning Analyst I	9
0542	Statistician I	33
1601	Community Research Analyst I	5
1471	Aquatic Biologist I	5
	31C $8,580-$10,432	
0824	Administrative Analyst	11
	32 $8,163-$10,954	
3602	Medical Research Technician II	29
	32B $8,580-$10,954	
6211	Game Biologist I	3
	33 $8,580-$11,501	
1061	Industrial Research Analyst I	0
	34 $9,011-$12,075	
5261	Plant Pathologist	1
0122	Systems Analyst II	1
1621	Planning Analyst II	6
0543	Statistician II	42
0552	Biostatistician I	1
5251	Botanist	0
1602	Community Research Analyst II	1
	34B $9,454-$12,075	
1472	Aquatic Biologist II	4
	36 $9,923-$13,301	
2446	Educational Research Assistant	4
6212	Game Biologist II	7

Class Code	Pay Range--Title	Number of Incumbents
	37 $10,432-$13,979	
0123	Systems Analyst III	1
0845	Management Research Associate I	1
1622	Planning Analyst III	14
1603	Community Research Analyst III	2
0544	Statistician III	19
0553	Biostatistician II	0
1662	Industrial Research Analyst II	2
3603	Medical Research Technician III	34
2452	Educational Statistics Specialist	7
	37C $11,501-$13,979	
5341	Poultry Pathologist I	2
5331	Veterinary Pathologist I	5
	38 $10,954-$14,657	
3620	Public Health Behavioral Research Associate	4
5426	Forest Geneticist	1
5448	Forest Entomologist	1
5451	Forest Pathologist	1
1473	Aquatic Biologist III	3
	39 $11,501-$15,387	
1663	Industrial Research Analyst III	1
	39B $12,075-$15,387	
2447	Educational Research Associate I	12
	40 $12,075-$16,170	
2453	Educational Statistics Supervisor	1
7840	Crime Commission Research Associate	3
0124	Systems Analyst IV	0
0846	Management Research Associate II	0
1623	Planning Analyst IV	15
1604	Community Research Supervisor	1
0545	Statistician IV	10
0544	Biostatistician III	0
	40C $13,301-$16,170	
5332	Veterinary Pathologist II	2
	41 $12,675-$16,978	
6213	Game Biologist III	1
1474	Aquatic Biologist IV	2
3611	Medical Research Scientist I	13
0559	Agriculture Planning, Evaluation and Research Director	1

Class Code	Pay Range--Title	Number of Incumbents
	41C $13,979-$16,978	
5342	Poultry Pathologist II	1
	42 $13,301-$17,839	
1664	Industrial Research Supervisor	1
0125	Systems Analyst V	0
1624	Planning Analyst V	8
0546	Statistician V	3
0555	Director of Statistics, Commerce	1
	43 $13,979-$18,725	
2448	Educational Research Associate II	8
3621	Public Health Behavioral Scientist I	2
1636	Research and Information Director, Community Affairs	1
	43C $15,387-$18,725	
5333	Veterinary Pathologist III	1
	44 $14,657-$19,664	
1605	Planning Supervisor	4
1640	Community Planning Director	1
0108	Management Systems Supervisor	1
0556	Employment Security Research and Statistics Director	2
0560	Planning, Research and Statistics Director, Crime Commission	1
4875	Social Welfare Research Director	0
	45 $15,387-$20,629	
1685	Director of Science and Technology	1
2454	Educational Statistics Director	1
5161	Agriculture Chemistry Director	1
5271	Plant Industry Director	1
1293	Coal, Planning and Research Director	1
0558	Revenue Research and Statistics Director	1
	46 $16,170-$21,672	
3622	Public Health Behavioral Scientist II	1
3612	Medical Research Scientist II	26
	47 $16,978-$22,768	
2449	Educational Research Director	2
	47C $18,725-$22,768	
5351	Animal Industry Director	1

Class Code	Pay Range--Title	Number of Incumbents
	48 $17,839-$23,915	
0557	Public Welfare Planning, Evaluation and Research Director	1
3613	Medical Research Scientist III	18
3627	Director of Public Health Research and Biostatistics	1
	48D $20,629-$23,915	
3623	Public Health Research Physician	1
	49 $18,725-$25,115	
3615	Clinical Medicine Research Director	0
	49D $21,672-$25,115	
3625	Medical Research and Education Director	0
	50 $19,664-$26,367	
2458	Educational Research and Statistics Director	0
	51 $20,629-$27,697	
1195	Deputy Secretary of Highways for Planning and Research	1
	51D $23,915-$27,697	
3617	Medical Research Director	2
3618	Mental Health Research and Training Director	0
	52D $25,115-$29,079	
3619	Psychiatric Institute Research Director	0
	Total	473

Appendix C: Office of Administration, Administrative Directive No. 47, January 20, 1969, Contracting for Consulting Services

This Directive supersedes Administrative Directive No. 5, issued March 6, 1967, entitled "Procedures to Use When Requesting Consultant Services."

This Directive describes the procedures to be used in securing consulting services in the areas of management systems, procedures, organization, electronic data processing, and similar processes. Agencies requesting consulting services are responsible for preparing a complete and thorough definition of the problem to be solved including a statement of the purpose and scope of the proposed study and for submitting this information to the Office of Administration for review.

The Bureau of Systems Analysis in the OA will take the following action on receipt of the problem definition and supporting data:

1. Determine whether the services requested can be performed by Office of Administration personnel or other Commonwealth employees.

2. Assign such personnel to perform the services if it is considered desirable to use their services.

3. If it is desirable to use independent consultants, formulate, in conjunction with the requesting agency, study specifications to be used in securing proposals.

4. Assist the requesting agency in locating qualified consultants who will be asked to submit proposals. Except where it is clearly not feasible to do so, proposals should be solicited from more than one consultant. An agency must fully justify the selection of a consultant on a "sole" source basis by submitting information explaining the unique capabilities of the consultant which indicate that a sole source award is appropriate.

5. Assist the agency concerned in the evaluation of proposals submitted by independent consultants in reply to the specifications.

6. Attend periodic progress meetings during the course of the study to evaluate the work of the consultants.

7. Follow up on the implementation of the approved recommendations made as a result of the study.

The following functions are to be performed by the agency when the services of an independent consultant have been determined to be necessary:

1. Request consultants selected in conjunction with the Bureau of Systems Analysis to submit proposals for the study on the basis of the specifications.

2. Form an evaluation committee and establish criteria to evaluate the proposals with assistance from the Bureau of Systems Analysis.

3. Select a consultant and submit the contract between the successful vendor and the agency to the OA for approval.

4. Assign a sufficient number of agency employees who understand the system to participate in the study to assure that maximum benefits are obtained from the study and to assist in the implementation of the recommendations after the consultants have left the scene.

5. Establish monthly progress report meetings with the consultant.

6. Furnish the Bureau of Systems Analysis with a copy of the final report of all consultant studies.

If the decision is made to use the services of Office of Administration personnel, the agency should immediately consult with such personnel to:

1. Determine the scope of the project.

2. Prepare a time schedule for the project.

3. Determine the number and the sources of personnel required to carry out the project.

The Pennsylvania State University
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407 Graduate Building
University Park, Pennsylvania 16802

LIST OF PUBLICATIONS

State Organization of Research and Development: A Case Study, Irwin Feller, Jon Nelson with Robert Friedman and James Mead, 1970.	$2.00
Proceedings of the Pennsylvania Science Policy Workshop, 1970.	1.00
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The Development and Utilization of Human Resources: A Guide for Research, Jacob J. Kaufman, Grant N. Farr, and John C. Shearer, July 1967, 77 pp.	1.00
The Potential of Vocational Education: Observations and Conclusions, Jacob J. Kaufman and Morgan V. Lewis, May 1968, 134 pp.	2.00
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